TO STUDY PROFILE OF INFECTIONS IN PATIENTS OF END STAGE RENAL DISEASE ON MAINTENANCE HEMODIALYSIS

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Submitted By

DR. SEJSHI LATVOSHI

DEPARTMENT OF MICROBIOLOGY
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA, PUNJAB

DECLARATION BY THE CANDIDATE

I hereby declare that the thesis entitled "**TO STUDY PROFILE OF INFECTIONS IN PATIENTS OF END STAGE RENAL DISEASE ON MAINTENANCE HEMODIALYSIS**" submitted towards partial fulfillment of the requirements for the award of **MD in Microbiology** degree to BFUHS is a compilation of original work carried out by me under the supervision of **Dr. Veenu Gupta,** Professor & Head, Department of Microbiology and **Dr. Vikas Makkar,** Professor & Head, Department of Nephrology. No part of this thesis has formed the basis for the award of any degree previously.

_____

Dr. SEJSHI LATVOSHI
Department of Microbiology,
Dayanand Medical College & Hospital,
Ludhiana, Punjab

Date:

Place:

CERTIFICATE OF SUPERVISORS

This is to certify that the work incorporated in this thesis entitled "**TO STUDY PROFILE OF INFECTIONS IN PATIENTS OF END STAGE RENAL DISEASE ON MAINTENANCE HEMODIALYSIS"** has been carried out by **Dr. Sejshi Latvoshi** under our direct supervision. The data incorporated in this thesis is original and genuine and has been carried out by the candidate herself.

Signature of Supervisor

Dr. Veenu Gupta
Professor & Head
Department of Microbiology
DMC&H, Ludhiana

Signature of Co-Supervisor

Dr. Vikas Makkar
Professor & Head
Department of Nephrology
DMC&H, Ludhiana

Date:

ENDORSEMENT BY THE HEAD OF THE INSTITUTE

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Dr. Sejshi Latvoshi
Department of Microbiology
Dayanand Medical College & Hospital,
Ludhiana, Punjab - 141001

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DEDICATED TO

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MY FRIENDS

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Dr. Sejshi latvoshi

ABBREVIATIONS

Abbreviation	Full Form
AV Fistula	Arteriovenous Fistula
BFI	Body Fluid Infection
BSI	Bloodstream Infection
CA	Community-Acquired Infection
CNS	Coagulase-Negative Staphylococci
CRBSI	Central line related blood stream infection
CSF	Cerebrospinal fluid
CVC	Central venous catheter
ESRD	End-Stage Renal Disease
HA	Hospital-Acquired Infection
Hb	Hemoglobin
HD	Hemodialysis
ICU	Intensive Care Unit
MDR	Multi-Drug Resistant
MRSA	Methicillin-Resistant Staphylococcus aureus
RTI	Respiratory Tract Infection
SD	Standard Deviation
SSTI	Skin and Soft Tissue Infection
UTI	Urinary Tract Infection
VRE	Vancomycin-Resistant Enterococci
XDR	Extensively Drug-Resistant

ABSTRACT

Introduction: ESRD signifies a clinical state characterized by an irreversible decline in endogenous renal function, necessitate permanent renal replacement therapy. Infections are the leading cause of morbidity and mortality in hemodialysis patients. The risk of bacteremia is higher along with other infections like fungal, TB and blood transmitted viral infections. They are responsible for significant proportion of hospital admissions.

Aims and Objectives: 1) To characterize various infections in maintenance hemodialysis patients of End stage renal disease.

Materials and Methods: This prospective study was conducted over a period of one year in the Department of Microbiology in Dayanand Medical College and Hospital, Ludhiana. Data was collected in pre-structured proforma, which included demographic details, risk factors, investigations, laboratory parameters, follow-up and outcomes. Samples were processed on the basis of clinical suspicion in department of microbiology were cultured and processed according to standard protocols. Identification and Antimicrobial-Susceptibility of bacterial isolates were done by BACTEC and VITEK I/D system. Samples for suspicion of TB were processed by ZN and CBNAAT.

Results: In this study total 673 patients were enrolled,226 patients were observed with various infections (infection rate 33.5%).166 patients had bacterial infections,28 viral,25 fungal & 7 tubercular infection. Further bacterial infections were characterized. In 203 episodes of infection, 225 infections were observed. Most common infection was UTI (54.3%). Most predominant isolates were Gram negative (77.3%), (*K.pneumoniae* (36.3%) followed by *E.coli*(32%)). Gram negative isolates showed maximum susceptibility to Amikacin, Gentamicin and Cefoperzaone + sulbactum.

Conclusion: This study comprehensively delineates the spectrum & incidence of infections among ESRD patients on maintenance HD, highlighting the diverse pathogens and clinical challenges encountered in this vulnerable population. These findings underscore the importance of management approaches to improve outcomes in this high risk cohort.

Keywords: Hemodialysis, End stage renal disease, Automated methods.

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Sadiq Road, Faridkot-151203 (Pb.) INDIA
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INTRODUCTION

End-stage renal disease (ESRD) signifies a clinical state characterized by an irreversible decline in endogenous renal function, necessitating permanent reliance on renal replacement therapy. The population undergoing maintenance hemodialysis is witnessing a yearly increase of 9% [1]. Numerous chronic conditions can precipitate end-stage renal disease, with diabetes mellitus emerging as the primary cause in both developed and developing nations. This is closely followed by hypertension and vascular diseases such as renal artery stenosis and hypertensive nephrosclerosis. Additionally, various glomerular diseases including membranous nephropathy, immunoglobulin A nephropathy, minimal change disease, focal and segmental glomerulosclerosis, as well as tubulointerstitial diseases, contribute to its etiology [2]. Dialysis patients are prone to infections due to a combination of factors including advanced age, compromised primary host defence mechanisms, and the presence of co-morbid conditions such as malnutrition and diabetes mellitus. Additionally, invasive dialysis procedures can disrupt the integrity of the skin and mucosal barriers, further increasing susceptibility to infections [3]. In patients with end-stage renal disease (ESRD), infections stand as a significant contributor to both morbidity and mortality [4]. It stands as the second leading cause of death among end-stage renal disease (ESRD) patients, as reported by the United States Renal Data System (USRDS). Septicemia emerges as the most prevalent factor, contributing to over 75% of these infectious fatalities. Among dialysis patients with renal failure, the overall mortality rate is 176 deaths per 1000 patients per year, with septicemia and pulmonary infections collectively accounting for nearly 26 deaths per 1000 patients annually[5]. Hemodialysis is a life-saving renal replacement therapy for ESRD patient. It is essential for failed kidneys, those cannot perform their natural detoxifying function. This procedure involves circulating blood outside the body through a dialysis machine, and this machine is equipped with a dialyzer, referred as artificial kidney, which filters

waste products, excess fluids and electrolytes from the blood. The dialyzer, contains thousands of tiny synthetic hollow fibers, through which blood flows and dialysate flows around them. Thus, harmful substances, passes through the walls of fibers into the dialysate, that mimics the natural filtration process of normal healthy kidneys. The frequency of hemodialysis depends upon the individual medical needs and each session usually lasts about four hours. The regular schedule is crucial to maintain a balance of body chemicals and to prevents from harmful build-up of waste and fluid in body. So, it is a delicate balance; if too infrequent dialysis have done, it causes harmful fluid overload and accumulation of toxins that can be fatal. While overly frequent phenomenon can cause rapid shifts in body fluids and can cause serious complications [6]. In the past few decades, significant progress has been made in understanding the pathogenesis of bacterial infections in hemodialysis (HD) patients. Three pivotal factors are host immunity, bacterial virulence, and the dialysis procedure. 1) Impaired Host Immunity: Uremia is associated with variations in primary host defense mechanisms, increasing the risk of bacterial infections. Neutrophils exhibit impaired chemotaxis, oxidative metabolism, phagocytic activity, degranulation, intracellular killing, and apoptosis [7-10]. Factors contributing to neutrophil dysfunction include malnutrition, iron overload, trace element deficiencies, hyperparathyroidism, impaired glucose metabolism, dialysis itself, and uremic retention solutes [11-14]. 2) Bacterial Virulence and Adherence Properties: Bacteria can acquire virulence properties under specific conditions. Normally, low-density bacteria are cleared by primary host-defense mechanisms. However, under high-density conditions, bacteria can produce extracellular polysaccharides, known as "quorum sensors." These molecules are secreted by the bacteria and freely diffuse within the bacterial community, interacting with transcriptional activators such as LasR and RhIR. This interaction expands the expression of virulence genes, facilitating bacterial survival by increasing the production of proteases, superoxide dismutase, and catalase, allowing the organism to evade neutrophil killing and the bactericidal or

bacteriostatic effects of antimicrobial agents [15,16]. Bacteria as well forms a matrix of extracellular polysaccharides, known as biofilm or slime. 3) The Hemodialysis Procedure: During HD, patients are exposed to various infection risks. Potential sources of infections include the skin (due to repeated disruptions of the skin barrier and integrity related to vascular access type), the dialysis water treatment system, and dialyzer reuse [17]. Four pathogenic pathways are implicated in the development of catheter-related bloodstream infections, in order of descending frequency: 1) Cutaneous catheter tract and tip contamination with skin flora; 2) Catheter hub contamination, due to intraluminal colonization. 3) From another focus of infection, hematogenous seeding to the catheter, 4) Intraluminal contamination of the catheter with solvent/infusate, though this is very rare [18]. According to various literature, *Staphylococcus aureus,* a Gram-positive bacterium, constitutes 28-65% of isolates in the blood cultures of hemodialysis patients, making it the most prevalent, while approximately 45% are Gram-negative. This bacterial profile is closely linked to elevated mortality rates. The occurrence of septic shock and polymicrobial infections significantly elevates mortality rates within this demographic [19]. Nevertheless, the escalating utilization of antibiotics and frequent interaction with healthcare settings have contributed to a surge in infections caused by multidrug-resistant organisms. According to a study by Calfee et al., methicillin-resistant *S. aureus* stands out as the most prevalent pathogen, trailed by vancomycin-resistant enterococci and multidrug-resistant Gram-negative bacilli [20]. The symptoms of bacteremia typically include fever, chills, leukocytosis, or hypotension. Blood cultures are typically obtained when patients present with such symptoms. If only one blood culture is positive for skin contaminants like *coagulase-negative Staphylococcus* or aerobic gram-positive rods, and there's no clinical evidence of infection, it's usually considered a contaminant. However, in all other scenarios, at least one positive blood culture with clinical evidence of infection is classified as bacteremia [3]. The annual mortality rate due to sepsis is approximately 100 to 300 times higher in dialysis patients [21]. As per

one another study, bacteremia significantly increases the risk of subsequent death, heart failure, myocardial infarction, peripheral vascular disease, and stroke [22]. One more indicates that first-year hospital admission rates for bacteremia were higher for hemodialysis patients compared to those on peritoneal dialysis [23]. However, an additional study conducted at a single dialysis center indicated that the overall infection rate was similar between hemodialysis and peritoneal dialysis patients. The primary difference was the type of infection: hemodialysis patients were at a higher risk for bacteremia, while peritoneal dialysis patients were more prone to peritonitis [24]. Risk factors vary from study to study. The main risk factor is temporary vascular access via a central venous catheter (CVC), which includes CVC-related local infections and CVC-related bloodstream infections. CVC-related bloodstream infections, in particular, contribute significantly to increased healthcare costs, morbidity, and mortality [25]. The incidence of end-stage renal disease plateaued between 2007 and 2011, then increased again in 2012 from 357.2 per million per year to 372.4 per million per year. In the United States, more than 80% of patients with ESRD initiate hemodialysis using a catheter, while the use of arteriovenous fistulas increased by only 5% (from 12% in 2005 to 17% in 2016). Power et al. reported that 11.7% of hemodialysis patients developed at least one episode of septicemia during seven years of follow-up. In a recent dialysis event surveillance report, Patel et al. reported that 78.7% of bloodstream infections were related to central venous catheters, compared to 58.4% in arteriovenous grafts and 47.6% in arteriovenous fistulas [26]. North American data shows that the rate of bloodstream infections in hemodialysis patients ranges from 0.5 to 27.1 per 100 patients per month, depending on the type of access used. More recent studies have reported a reduction in the incidence of bloodstream infections in this population, from 1.09 to 0.89 per 100 patients per month, and after the implementation of specific control measures, it further decreased from 2.04 to 0.75 per 100 patients per month [27]. Multidrug-resistant *Staphylococcus aureus* was the most common pathogen causing bloodstream infections. The

administration of mupirocin at the CVC insertion site in hemodialysis-dependent patients significantly reduced the risk of colonization and bacteremia by *Staphylococcus aureus* [28].

Bacteremia can arise from contamination of dialysis fluids or equipment, insufficient reprocessing of dialyzers, or improper treatment of municipal water utilized in dialysis [29]. Complications related to vascular access or dialysis include bleeding, local or disseminated intravascular infections, graft occlusion, electrolyte abnormalities, dialysis dementia, and dialysis disequilibrium syndrome [30]. Several factors, including older age, diabetes, heart failure, pulmonary disease, inability to ambulate, low serum albumin levels, and cancer, have been linked to a heightened risk of specific or overall infections in patients undergoing dialysis therapy. Individuals with diabetes mellitus (DM) are particularly susceptible to infections. End stage renal disease is a progressive disorder and to prevent death in these patients timely replacement therapy is necessary. The frequent infections associated with numerous hospitalizations, increased health care cost and metabolic changes and mortality rate is significantly higher in these patients than those without disease [31].

To achieve this objective, the proposed study aimed to observe the incidence and characterize the types of infections occurring in end-stage renal disease patients undergoing maintenance hemodialysis.

AIMS AND OBJECTIVES

To characterize various infections in maintenance Hemodialysis patients of End stage renal disease.

REVIEW OF LITERATURE

1. Overview

A. End-Stage Renal Disease (ESRD) and its Prevalence

End-Stage Renal Disease (ESRD) marks the most advanced stage of chronic kidney disease (CKD), characterized by a drastic reduction in kidney functionality, typically identified by a glomerular filtration rate (GFR) of less than 15 ml/min/1.73 m^2. The journey to ESRD is marked by a progressive decline in kidney function, resulting in the accumulation of waste products, electrolyte imbalances, and fluid retention, primarily due to glomerulosclerosis, tubulointerstitial fibrosis, and ongoing nephron loss. The predominant causes of ESRD are diabetes mellitus (diabetic nephropathy) and hypertension, which together contribute to a significant number of cases globally. Other contributing factors include chronic glomerulonephritis, polycystic kidney disease, autoimmune disorders, and congenital anomalies of the kidney and urinary tract. Luyckx VA *et al*.[32]

Globally, ESRD represents a significant health concern with a prevalence that varies based on age, race, socioeconomic status, and the prevalence of underlying conditions such as diabetes and hypertension. The Global Burden of Disease Study indicates a rising incidence of ESRD, partly attributable to an aging population and the growing prevalence of risk factors. Patients with ESRD commonly experience symptoms like fatigue, weakness, nausea, anorexia, and altered mental status. They are also prone to various complications including cardiovascular diseases, anemia, bone disorders, acid-base imbalances, and an increased risk of infections.

The management of ESRD primarily involves renal replacement therapies such as hemodialysis, peritoneal dialysis, and kidney transplantation. Hemodialysis, a prevalent form of renal replacement therapy, utilizes a machine and a filter to cleanse the blood of waste products and excess fluid. The use of hemodialysis is widespread, with its prevalence varying according to the availability of medical resources, healthcare policies, and patient preferences. Recent data

shows that a significant portion of patients with ESRD are on maintenance hemodialysis, underscoring its vital role in the management of this condition. Delatorre T *et al*.[33]

B. Significance of hemodialysis in managing ESRD.

Hemodialysis is a critical component in the management of End-Stage Renal Disease (ESRD), a severe condition where the kidneys have lost almost all their functioning capacity. This therapy is not merely life-sustaining but also plays a significant role in enhancing the quality of life for those affected by ESRD. The principle of hemodialysis involves replicating the kidney's filtration process using a dialyzer or artificial kidney, which helps remove waste products, excess fluids, and electrolytes from the blood, thereby maintaining a balance when the kidneys are no longer able to do so effectively.

One of the most notable impacts of hemodialysis has been the remarkable improvement in the survival rates of ESRD patients. Before the introduction of hemodialysis, ESRD was typically a fatal condition. However, with regular hemodialysis, patient survival has significantly increased. Additionally, hemodialysis greatly enhances the quality of life by alleviating symptoms of uremia and restoring fluid and electrolyte balance, which in turn reduces physical limitations and enables a more active lifestyle for patients. Lakshminarayana GR *et al*.[34]

Hemodialysis is also crucial in managing complications linked to uremia, such as anemia, acidosis, and hyperkalemia. Effective management of these complications is vital to prevent potentially life-threatening conditions. Furthermore, the flexibility and accessibility of hemodialysis make it an appealing option for many patients, as it can be performed in various settings, including hospitals, dialysis centers, or even at home, depending on individual circumstances and preferences.

The psychosocial benefits of regular hemodialysis sessions also cannot be understated. These sessions often provide valuable opportunities for social interaction and psychological support, which are essential for the emotional well-being of patients dealing with chronic

illnesses. However, despite these numerous benefits, hemodialysis comes with its own set of challenges. It demands a lifelong commitment to regular treatment sessions and carries the risk of complications, particularly infections at the vascular access site. Yonata A *et al*.[35]

Hemodialysis stands as a fundamental approach in managing ESRD, significantly contributing to both the prolongation of life and enhancement of its quality. The role of hemodialysis in managing ESRD complications, especially in terms of infection risks and management, remains a critical area for ongoing clinical interest and research.

C. Brief introduction to the common types of infections in ESRD patients undergoing hemodialysis.

Patients with End-Stage Renal Disease (ESRD) undergoing maintenance hemodialysis are particularly vulnerable to a range of infections, a consequence of their compromised immune systems and the invasive nature of the hemodialysis procedure. This heightened susceptibility underscores the importance of understanding these infections for effective prevention and management.

Vascular access infections stand out as the most prevalent type in hemodialysis patients. These infections typically occur at the sites of arteriovenous fistulas, arteriovenous grafts, or central venous catheters. The most common pathogens responsible include *Staphylococcus aureus* and various Gram-negative organisms. Furthermore, Bloodstream Infections (BSIs) are a major concern in this patient group, frequently stemming from vascular access site infections. Such BSIs can lead to severe complications, including sepsis, and are often caused by *Staphylococcus aureus*, including methicillin-resistant strains (MRSA), along with Gram-negative bacteria. Soi V *et al*.[36]

Despite diminished urine output, Urinary Tract Infections (UTIs) can still occur, particularly in ESRD patients who retain some renal function. *Escherichia coli* and other Enterobacteriaceae are typically responsible for these infections, which can be complex and necessitate careful

antibiotic management. Respiratory infections, such as pneumonia, also pose a significant risk to ESRD patients. These are commonly induced by factors like fluid overload and an increased risk of aspiration, with *Streptococcus pneumoniae* and *Haemophilus influenzae* being frequent causative agents. Nigam SK et al. [37]

Viral infections are another area of concern. Hepatitis B and C are particularly worrisome in hemodialysis units due to the potential for blood-borne transmission. Additionally, viral infections like influenza and COVID-19 can have serious consequences for ESRD patients on hemodialysis. Skin and soft tissue infections are also common, often exacerbated by the compromised skin integrity from repeated vascular access punctures. These infections, typically caused by *Staphylococcus aureus*, can range from milder forms like cellulitis to more severe manifestations such as necrotizing fasciitis. Dhondup T et al. [38]

The susceptibility of ESRD patients on hemodialysis to a diverse array of infections, with vascular access infections being the most common, highlights the necessity for stringent infection control measures. Coupled with timely diagnosis and appropriate antibiotic therapy, these measures are critical in managing infections and improving patient outcomes in this vulnerable population. Syed-Ahmed M et al.[39]

2. Pathophysiology of ESRD and Impact on Immune System

End-Stage Renal Disease (ESRD) is the final stage of chronic kidney disease (CKD), marked by severe kidney function loss, characterized by the inability to filter waste and regulate bodily functions effectively. Understanding the pathophysiology of ESRD, which includes the progressive loss of nephrons, is essential. This leads to a decline in the glomerular filtration rate (GFR), and while healthy nephrons try to compensate through adaptive hyperfiltration, this can accelerate nephron loss. Uremia, resulting from the accumulation of waste products like urea and creatinine, affects multiple body systems, causing symptoms such as nausea, vomiting, fatigue, and neurological impairments, significantly impacting patients' quality of life. Additionally,

ESRD impairs the kidneys' ability to manage fluid, electrolyte, and acid-base balance, leading to complications like hyperkalemia, metabolic acidosis, and fluid overload, which can cause hypertension, pulmonary edema, and heart failure. The disease also disrupts endocrine and metabolic functions, leading to anemia and renal osteodystrophy due to reduced erythropoietin production and imbalances in calcium and phosphate. ESRD patients often experience altered glucose metabolism due to insulin resistance and decreased insulin degradation. Immunologically, ESRD patients have compromised phagocytic function, reduced lymphocyte count, and altered cytokine profiles, increasing susceptibility to infections. Furthermore, ESRD patients have an elevated risk of cardiovascular diseases due to chronic inflammation, hypertension, and dyslipidemia, making cardiovascular health a critical focus. Espi M et al. [40]

ESRD significantly impacts the immune system, increasing patients' vulnerability to infections. The dysfunction in the innate immune system, including reduced neutrophil and monocyte functionality, weakens the body's initial defense against pathogens. Compromised chemotaxis, phagocytosis, and intracellular killing in neutrophils critically impair the body's ability to combat bacterial infections. Additionally, ESRD adversely affects adaptive immunity, reducing the number and functionality of lymphocytes, hindering the response to new antigens and the development of effective immune memory. Uremic toxins exacerbate immune dysfunction by inhibiting immune cell functions and disrupting cytokine production, leading to chronic inflammation. Hemodialysis further impacts the immune system, activating complement pathways and leukocytes, creating a pro-inflammatory state. The use of central venous catheters increases the risk of catheter-related bloodstream infections. Nutritional deficiencies, common in ESRD due to dietary restrictions and altered metabolism, further impair immune function, increasing susceptibility to infections. Chang CH et al.[41]

Patients with ESRD often have multiple comorbid conditions that heighten their susceptibility to infections. Diabetes Mellitus impairs

immune function and wound healing, increasing the risk of infections, particularly urinary tract and skin infections. Cardiovascular diseases in ESRD patients compromise blood flow and oxygen delivery, impairing immune response and tissue repair. Chronic lung diseases, like COPD, increase the risk of pulmonary infections due to impaired respiratory function. Hepatic diseases affect the production of immune factors, making it challenging to fight infections. Autoimmune disorders, such as Systemic Lupus Erythematosus (SLE), further impair immune function, increasing vulnerability to infections. Malnutrition and vitamin deficiencies, stemming from dietary restrictions and altered metabolism, debilitate the immune system. Psychosocial factors, including depression and stress, prevalent in ESRD patients, weaken the immune system, indirectly elevating infection risk. The presence of multiple comorbid conditions significantly escalates the risk of infections in ESRD patients, necessitating vigilant monitoring and proactive management to mitigate infection incidence in this vulnerable population. Gembillo G et al.[42]

3. Hemodialysis: Procedure and Infection Risk

Hemodialysis is essential for End-Stage Renal Disease (ESRD) patients, filtering waste and excess fluids from the blood when kidneys can no longer do so. The procedure involves circulating the patient's blood through a machine where it passes across a semipermeable membrane within the dialyzer (artificial kidney). This removes toxins and corrects fluid and electrolyte imbalances. Vascular access is prepared via arteriovenous (AV) fistulas, AV grafts, or central venous catheters, with AV fistulas and grafts preferred for long-term use due to lower infection rates. Blood is drawn from the patient, filtered through the dialyzer, and returned to the body, driven by diffusion and ultrafiltration. Gorsane I et al.[43]

A typical hemodialysis session lasts about four hours and occurs three times a week, although duration and frequency can vary. The dialysate composition is carefully controlled to maintain the patient's electrolyte and fluid balance, and patient vital signs are monitored throughout the

session. Despite its benefits, hemodialysis carries infection risks, especially at vascular access sites, which can lead to localized or bloodstream infections. Proper care, sterile techniques during needle insertion, and regular monitoring are crucial to mitigating these risks. Karkar A et al.[44]

Infections are a major complication for ESRD patients on hemodialysis, with Central Venous Catheters (CVCs) posing the highest risk due to their external nature. Inadequate catheter care, such as poor hand hygiene and lack of aseptic techniques, increases infection risks. ESRD patients' compromised immune systems, compounded by uremia, diabetes, and certain medications, further heighten their vulnerability. Age, comorbidities, malnutrition, and psychosocial factors like stress also contribute to infection susceptibility. Vijayan A et al.[45]

Preventive measures are vital in reducing infection risks during hemodialysis. Strict hand hygiene, aseptic techniques, and barrier precautions are essential. Using AV fistulas or grafts over CVCs, regular monitoring of access sites, and continuous education for healthcare workers and patients enhance infection control. Cleaning and disinfection of the dialysis environment, robust infection surveillance, antimicrobial stewardship, and up-to-date vaccinations are critical. Educating patients on personal hygiene and recognizing infection signs empowers them in their care. Isolation protocols for contagious patients prevent infection spread within hemodialysis units. These comprehensive strategies safeguard ESRD patients, ensuring safer and more effective hemodialysis treatments. Suzuki M et al.[46]

4. Types of Infections in Hemodialysis Patients

Hemodialysis patients with End-Stage Renal Disease (ESRD) are at increased risk of infections due to their compromised immune system and the invasive nature of the procedure. Common infections include:

1. **Vascular Access Infections:** These occur at the site of arteriovenous (AV) fistulas, AV grafts, or central venous catheters and can lead to localized or systemic infections like bacteremia.

2. **Bloodstream Infections (BSIs):** BSIs, including sepsis, are significant concerns, often originating from vascular access infections or contaminated equipment.
3. **Urinary Tract Infections (UTIs):** Despite low urine output, UTIs can occur, particularly in patients with residual kidney function or urinary tract abnormalities. Duong MC et al.[47]
4. **Respiratory Infections:** Hemodialysis patients are more susceptible to respiratory infections like pneumonia due to fluid overload, aspiration risk, and a weakened immune response.
5. **Skin and Soft Tissue Infections:** These infections, including cellulitis and abscesses, are common due to repeated needle insertions.
6. **Hepatitis B and C:** These viral infections are a concern in hemodialysis units due to potential blood-borne transmission.
7. **Gastrointestinal Infections:** These can result from contamination and lead to conditions like gastroenteritis.

Classification of Infections: Infections in hemodialysis patients include bacterial, viral, and fungal types, each requiring specific prevention, diagnosis, and treatment approaches.

Bacterial Infections: *Staphylococcus aureus*, including MRSA, is common in vascular access infections and BSIs. Gram-negative bacteria like *Escherichia coli* and *Pseudomonas aeruginosa* cause UTIs and systemic infections. Tsikala-Vafea M et al.[48]

Viral Infections: Hepatitis B and C, transmitted via blood, are significant risks. Influenza and SARS-CoV-2 pose additional threats, emphasizing the need for vaccination and respiratory hygiene.

Fungal Infections: Candida species are major culprits in catheter-related infections, while *Aspergillus species* can cause severe invasive infections in immunocompromised patients.

Effective infection management in hemodialysis patients involves routine surveillance, prompt diagnosis, and appropriate antimicrobial therapy. Preventive strategies include strict infection control practices, proper care of vascular access, judicious antibiotic use, and vaccination against hepatitis B, influenza, and pneumococcal disease.

Educating patients on personal hygiene and recognizing infection signs is also crucial. These measures aim to reduce infection incidence and improve outcomes for hemodialysis patients. Lea-Henry TN et al.[49]

5. Antimicrobial Resistance in ESRD Patients

Antimicrobial resistance (AMR) is a significant challenge in managing infections in End-Stage Renal Disease (ESRD) patients undergoing hemodialysis. These patients have compromised immune systems and frequent vascular access needs, increasing exposure to healthcare-associated pathogens. Extensive antibiotic use, hospitalizations, and invasive procedures contribute to the development and spread of resistant bacterial strains like methicillin-resistant *Staphylococcus aureus* (MRSA) and multidrug-resistant (MDR) Gram-negative bacteria. This complicates treatment, increases morbidity, prolongs hospital stays, and raises healthcare costs. Addressing AMR requires stringent infection control, judicious antibiotic use, and regular surveillance. Wang TZ et al.[50]

Antibiotic Use in ESRD Patients: Managing infections in ESRD patients involves navigating altered pharmacokinetics and pharmacodynamics due to reduced renal function. Antibiotic administration requires careful dosage adjustments and timing, often post-dialysis, to balance efficacy and minimize toxicity. The selection of antibiotics depends on the infection type, local antimicrobial susceptibility patterns, and the drug's behavior in renal impairment, starting with broad-spectrum antibiotics and refining based on culture results. Vigilant monitoring for adverse effects is essential due to increased sensitivity. Antimicrobial stewardship programs are crucial in optimizing antibiotic usage, enhancing outcomes, and curtailing AMR by ensuring appropriate antibiotic selection, dosing, and therapy duration. Song JU et al.[51]

Challenges of Antimicrobial Resistance: ESRD patients face heightened infection risks due to frequent healthcare interactions, central venous catheters, and other invasive devices, which serve as entry points for pathogens. The unique physiology of ESRD

complicates antibiotic distribution, metabolism, and elimination, necessitating dosage adjustments to avoid toxicity and achieve therapeutic levels. The presence of AMR limits effective antibiotic options, often necessitating broader-spectrum or more toxic agents, increasing adverse effects, and driving further resistance. Hemodialysis can significantly reduce plasma concentrations of highly dialyzable drugs, requiring meticulous timing and supplemental dosing to maintain effective levels. Apata IW et al.[52]

Infection control within dialysis units is challenging, with the need for stringent measures, continuous surveillance, adherence to hygiene protocols, and isolation precautions. Infections caused by resistant bacteria lead to increased morbidity, mortality, and healthcare costs due to prolonged infections, extended hospital stays, and escalated use of resources. Hemodialysis units can become reservoirs for MDROs, highlighting the importance of antimicrobial stewardship programs to optimize antibiotic use and prevent the transmission of resistant bacteria. Through concerted efforts in infection control, antimicrobial stewardship, and patient management, the healthcare community can mitigate AMR's impact, improving outcomes and safe-guarding public health.

C. Review of studies on antimicrobial resistance patterns in infections among hemodialysis patients

Kovesdy CP discussed chronic kidney disease (CKD), a progressive condition affecting over 10% of the global population, with higher prevalence among older adults, women, racial minorities, and those with diabetes or hypertension. CKD imposes a significant burden, especially in low- and middle-income countries, and has become a leading cause of mortality. Intensified prevention and treatment strategies are needed.[53]

Wu PJ et al. studied 1668 patients with cardiac implantable electronic devices (CIEDs) from 2012 to 2019 to assess infection risks in those with chronic kidney disease (CKD). Bundled skin antiseptic preparation reduced CIED infection rates to levels similar to non-CKD patients.

Despite this, CKD patients had higher cardiovascular and all-cause mortality rates.[54]

Suzuki M et al. highlighted the high infection risk in hemodialysis patients, with bacteremia being 26 times more likely than in the general population. Gram-positive bacteria, particularly methicillin-resistant *Staphylococcus aureus* (MRSA), are common culprits. Infection control measures, including antibiotic locks and CDC-recommended bundles, significantly reduce bacteremia incidence.[46]

Sugianli AK et al. reviewed antimicrobial resistance (AMR) in urinary tract infections (UTIs) in the Asia-Pacific region. High resistance rates were found for trimethoprim/sulfamethoxazole, ciprofloxacin, and ceftriaxone, especially in Bangladesh, India, Sri Lanka, and Indonesia. The study calls for improved AMR surveillance to guide empirical treatment.[55]

Ferdosi-Shahandashti E et al. assessed *Escherichia coli* resistance in urinary tract infections (UTIs) at Ayatollah Rouhani Teaching Hospital. Imipenem, ofloxacin, and ciprofloxacin showed high sensitivity, while cotrimoxazole and ceftriaxone exhibited high resistance. Disk diffusion demonstrated reliable sensitivity and specificity, guiding effective empirical UTI treatment.[56]

Beirão EM et al. evaluated ceftolozane-tazobactam's activity against multi-drug resistant Gram-negative bacilli (GNB) in Brazilian hospitals. The antibiotic showed high effectiveness against *Escherichia coli* and *Pseudomonas aeruginosa*, offering a promising option for resistant infections. The study also investigated β-lactamase encoding genes, emphasizing the importance of targeted antibiotic use.[57]

Khadka S et al. examined antibiotic resistance in *Salmonella Typhi* isolates from febrile patients in Kathmandu, Nepal. The study found high resistance to fluoroquinolones but high susceptibility to first-line antibiotics and cephalosporins. The findings highlight the need for cautious antibiotic selection in treating typhoid fever.[58]

Collignon PJ et al. emphasized reducing the use of critically important antimicrobials in food animals to prevent antimicrobial resistance. The World Health Organization's updated rankings guide risk management

in agriculture, prioritizing the reduction of quinolones, cephalosporins, macrolides, and glycopeptides use to protect human medicine efficacy.[59]

Mortazavi-Tabatabaei SAR et al. reviewed antibiotic resistance in urinary tract infections (UTIs) in Iran. *Escherichia coli* was the most common pathogen, showing high resistance to several antibiotics, including ampicillin and amoxicillin. The study suggests imipenem and nitrofurantoin as effective options for initial UTI treatment.[60]

Ahmed SS et al. investigated uropathogen prevalence and antimicrobial resistance in Qassim, Saudi Arabia. Among 273 urine samples, 89 showed significant growth, with 92% exhibiting drug resistance. *Escherichia coli* was the most common isolate, highlighting the need for strategies to combat multidrug-resistant bacteria in outpatient settings.[61]

Basak S et al. assessed multidrug-resistant (MDR), extensively drug-resistant (XDR), and pandrug-resistant (PDR) bacterial isolates in a tertiary care hospital. Among 1,060 bacterial strains, 37.1% were MDR, and 13.8% were XDR. Continuous monitoring is crucial for effective antimicrobial resistance management.[62]

MATERIAL AND METHODS

The present prospective study was conducted on End Stage Renal Disease patients on maintenance hemodialysis. It includes enrollment of patient for one year and follow up of those patients for six months has done in the Department of Microbiology, DMCH & Hospital, Ludhiana.

Source of Data:

This study was conducted on patients on maintenance hemodialysis from OPD over a period of one year in Dayanand Medical College and Hospital, Ludhiana.

METHOD OF COLLECTION OF DATA

Inclusion Criteria:

a) Adult patients (aged >18 years) diagnosed with End-Stage Renal Disease (ESRD) and on regular maintenance hemodialysis.

Exclusion Criteria:

a) Pregnant women undergoing hemodialysis.
b) Patients with a history of kidney transplantation currently on hemodialysis.
c) Individuals diagnosed with Acute Kidney Injury (AKI).

Infections were characterized and co-relate with the clinical profile of patients on hemodialysis.

The study employed a meticulously designed structured proforma to collect comprehensive data on patients undergoing maintenance hemodialysis. It included

- Name
- Age
- Sex
- MRD number
- Date of admission

- Risk factors (old age/comorbidities/malnutrition/immune-compromised state)
- Date of insertion of venous access/catheterized and removed.
- Source of admission
- General investigations
- Provisional diagnosis
- Follow-up
- Outcomes

Sample Collection:

The study encompassed a diverse range of specimen types including blood, various body fluids (ascitic fluid, pleural fluid, cerebrospinal fluid (CSF)), respiratory samples (such as sputum, bronchoalveolar lavage (BAL), endotracheal secretions, and bronchial brushings), surgical drain fluid, pus, tissue samples, skin and corneal scrapings, and biopsy specimens

URINE SAMPLE

Collected mid-stream urine sample under aseptic conditions and in case of catheterized patients use a disposable syringe to collect the sample from urine port.

BLOOD SAMPLE

- **For Culture:** 10-20 ml of blood was collected from the antecubital vein under aseptic conditions using a disposable syringe and directly inoculated into BACTEC 9240/ BacT/ Alert culture bottles.
- **For Serology:** 2-3 ml of blood was collected and processed according to clinical requirements.

BODYFLUIDS SAMPLE

Such as Cerebrospinal fluid (CSF), pleural fluid, synovial fluid, and ascitic fluid was collected under aseptic precautions in a sterile container.

RESPIRATORY SAMPLES

Sputum**:** Was Collected under aseptic condition in a wide mouthed, sterile, leak-proof, screw capped container under all aseptic precautions.

Endotracheal (ET) secretions: ET secretion was collected using a 22-inch Romson's 12 FG suction catheter with a mucus extractor which was gently introduced through the endotracheal tube for a distance of approximately 25–26 cm.

Bronchoalveolar Lavage (BAL): Sample was collected using flexible fiberoptic bronchoscope. About 30-50 ml of physiological saline was infused through fiberoptic bronchoscope into peripheral bronchiolar ramification.

PUS SAMPLE

Samples were collected under aseptic conditions using sterile universal containers. Pus and discharges from wounds (including post-operative wounds, other types of wounds, burn wounds, and abscesses) were obtained using sterile cotton-tipped swabs or syringes.

STOOL SAMPLE

Sample collection was done in a sterile, clean, wide-mouthed container without contamination from urine, water, or disinfectants.

SAMPLE PROCESSING

Samples received in the Microbiology laboratory were processed according to the standard protocols.

Direct Examination:

- **Gram Staining:** Smear was prepared from received samples.

  Staining technique:

  1) Step 1 (primary stain): with Crystal violet for 1 min then water rinsed.

  2) Step 2 (Mordant): Gram’s iodine for 1 min.

3) Step 3 (Decolorization): with Acetone for 2-3 seconds or 95% ethyl alcohol for 20-30 seconds then water rinsed immediately.

4) Step 4 (Counterstain): with Dilute carbol- fuschin or safranin for 30 seconds then water rinsed and blotted.

5) Examined under microscope at 100x oil immersion field [63]

- **KOH Mount:** 20% KOH used for the identification of fungal elements.

  Potassium hydroxide mount [KOH]

  Composition of KOH : Potassium hydroxide 10gm

  Glycerol 10ml

  Distilled water 80 ml

A drop of potassium hydroxide solution was placed on a clean microscopic slide. The sample was transferred to the drop of KOH and mixed gently with inoculating loop. A cover slip was placed over it [64].

- **ZN Staining:** Smear prepared for detection of acid-fast bacilli.

  Staining technique:

  1) Step 1 (primary stain): with strong carbol- fuschin 1% for 5 min with intermittent heating done by flaming the underneath of the slides until vapor rised.
  2) Step 2 (Decolorization): Done by pouring 25% sulfuric acid over the slide allowing it to stand for 2-4 min. Then gently rinsed with water and tilted to drain off the water.
  3) Step 3(Counter-stain): with 0.1% methylene blue poured onto slide and left for 30 seconds. Then gently rinsed with tap water and allowed to dry.
  4) Examined under microscope at 100x oil immersion field.

- **For CSF (**Cerebrospinal fluid)- Wet mount prepration, India ink preparation, Bacterial antigen and Cryptococcal Antigen was done.

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- **Stool:** Routine Examination for pus cells, RBCs, ova, cysts, and trophozoites. Tests for occult blood, Cryptosporidium smear, and GDH for Clostridium Difficile (Toxin A & B) conducted.

- **Bacterial Culture:**

Blood and body fluid specimens were processed using BACTEC 9240 or BacT/Alert. The blood culture bottles were incubated till the bottle indicate positive by the system for maximum period of 7 days. The Bac-T alert microbial detection utilizes a colorimetric sensor (colour changes from green to yellow), while the BACTEC uses flourescent light to monitor the presence and production of CO2 by the micro-organisms.

Smears were prepared from the positive culture bottles and Gram staining of the smears was done for Identification and also sub-cultured on Blood agar or MacConkey agar plates.

Urine, Respiratory samples, Pus, Swabs, Sputum cultured on Blood and MacConkey Agar, incubated at 37°C for 24-48hrs. Identification and Antibiotic Sensitivity Testing (AST) done by VITEK 2 system.

Stool Culture:

Processed on MacConkey, DCA, and Congo red Agar within 2 hours of receiving. Identification and AST performed on growth of colonies after 24 hours of incubation.

Mycobacterial Culture:

Samples cultured on LJ medium/MGIT after decontamination/centrifugation/homogenization, incubated for 6-8 weeks. ZN smear used for identification of acid-fast bacilli.

Fungal Culture:

Cultured on medium used

Sabouraud dextrose agar (SDA) with antibiotics and without cycloheximide

Composition and preparation:

Peptone	10gm
Dextrose	40gm
Agar	20gm
Distilled water	1000 ml
Chloramphenicol	50 mg
Gentamicin	20 mg

All ingredients were dissolved by boiling; antibiotics were added into SDA while boiling but before autoclaving. Chloramphenicol/ gentamicin were dissolved in 10 ml of 95% alcohol and added to boiling medium. The medium was dispensed in tubes and autoclaved at 121□C for 15 minutes and final pH was adjusted to 5.6. The medium was allowed to cool in slanting position and stored in the refrigerator[64].

Processing of sample for fungal culture:

The samples were inoculated on two tubes of Sabouraud dextrose agar (SDA) with antibiotics (chloramphenicol 50mg/1L and gentamicin 20mg/1L) and cycloheximide (500mg/1L) and two tubes of SDA with antibiotics but without cycloheximide. One set of tubes was incubated at 25□C. Similarly, other set were incubated at 37□C. The inoculated media were kept for a minimum period of three weeks. Tubes were examined daily during 1st week and on alternate days in 2nd and 3rd week. The growth obtained was identified on the basis of colony morphology, pigment production and microscopic examination of lactophenol cotton blue (LCB) preparation.

Identification

1.Organism was identified by studying the colony characteristics, germ tube test and speciation was done by using VITEK-2 YST panel.

2.Colony characteristics- white or yellow white colonies with a smooth or pasty consistency.

3.Germ tube test (GTT)

Serological Testing (As per Request):

Tests for HBsAg antigen, Anti-HCV, Anti-HIV, 1-3B-D Glucan Assay, Aspergillus Galactomannan, Leptospira IgM, Scrub Typhus IgM, Dengue IgM and NS1 Ag, CMV IgG & IgM, and PCT processed according to kit protocols.

Molecular Testing:

Conducted as per clinical suspicion, including HBV DNA, HCV RNA, CBNAAT/LPA, and BIOFIRE FIL ARRAY tests.

Outcome: The study will document whether the patients' conditions improved or worsened.

STATISTICAL ANALYSIS

Data was described in terms of range; mean ± standard deviations (±SD) frequencies (number of cases) and relative frequencies (%age) as appropriated. All statistical calculations were done using SPSS (statistical package for the social sciences). SPSS 21 version statistical program for Microsoft windows.

OBSERVATION AND RESULTS

This prospective study was done in Microbiology department in Dayanand Medical College and Hospital over a time period of 1.6 year in OPD patients with total of 673 consecutive cases, out of which 226 patients were observed with various infections (infection rate 33.5%).In 226 patients, 166 patients had only bacterial infection, 28 patients had viral infections, 25 patients were found with fungal infections and 7 patients were observed with tubercular infection.

Various samples were collected (urine, respiratory, blood, body-fluids, skin & soft tissue) on the basis of clinical suspicion and were processed as per standard protocol. Further 166 bacterial infections were characterized and 242 isolates were obtained. Majority of isolates were Gram negative 187 (77.3%) and 54 (22.3%) were Gram positive. Further isolates were processed for identification and AST done.

Following observation and results were made from this prospective study. Results are represented in the form of charts and graphs along with statistical analysis.

Table.1: Sex wise distribution of enrolled patients on hemodialysis (N=673)

SEX	**N (%)**
Male	459 (68)
Female	214 (32)
Total	673

In the present study, male predominance (68%) was seen over female (32%).

Table.2: Age wise distribution of enrolled patients on hemodialysis (N=673)

AGE GROUP (YEARS)	**N (%)**
< 20	3 (0.4)
20-30	38 (5.6)
31-40	71 (10.5)
41-50	98 (14.6)
51-60	178 (26.5)
61-70	203 (30.2)
>70	82 (12.2)
Total	673

The most common affected age group was 61-70 years (30.2%), followed by 51-60 years (26.5%)

Table.3: Characterization of clinical symptoms in enrolled patients at presentation (N=673)

CLINICAL SYMPTOMS	N (%)
Generalized weakness	384 (57.1)
Fever	363 (53.9)
Cough	273 (40.5)
Poor appetite	263 (39.1)
Shortness of breath	230 (34.1)
Pain in abdomen	129 (19.1)
Weight gain	91 (13.5)
Others	66 (9.8)

Most common clinical symptom in patients was generalized weakness (57.1%) followed by fever (53.9%) and cough (40.5%).

Table.4: Comorbidities in enrolled patients on hemodialysis (N=673)

COMORBIDITY	N (%)
Hypertension	547 (81.3)
Diabetes mellitus	454 (67.4)
Cardiovascular disease	118 (17.5)

The predominant comorbidity among hemodialysis patients was hypertension (81.3%) followed by diabetes mellitus (67.4%).

Table.5: Risk factors among enrolled patients on hemodialysis (N=673)

RISK FACTOR	N (%)
Anaemia	651 (96.7)
Hypotension	320 (47.5)
Fluid overload	290 (43.1)

The most common risk factor was anemia 651 (96.7%) followed by hypotension 320 (47.5%).

Table.6: Vintage at the time of enrollment (N=673)

DURATION (MONTHS/YEARS)	N (%)
0-3 month	195 (28.9)
3-6 month	63 (9.3)
6-12 month	105 (15.6)
1-2 year	99 (14.4)
2-3 year	127 (18.7)
3-4 year	70 (10.2)
>4 year	14 (2.9)

The table categorizes patients based on the length of time they have been receiving hemodialysis, in which the maximum number of patients receiving within 0-3 months 195 (28.9%).

Table.7: Distribution of dialysis frequency in enrolled patients (N=673)

FREQUENCY	N (%)
Once weekly	122 (18.2)
Twice weekly	300 (44.5)
Thrice weekly	131 (19.5)
Irregular	120 (17.8)

The frequency of dialysis was twice a week 300 (44.5%) in maximum number of patients, followed by thrice a week 131 (19.5%).

Table.8: Albumin values in enrolled patients

ALBUMIN VALUES (g/dl)	N (%)
<2.5	61(15.1)
2.5-3.0	88 (21.7)
3-3.4	118 (29.2)
3.5-3.9	86 (21.3)
>4	51 (12.7)

Out of 673 patients, albumin levels were done in 404 patients, in rest requisition was not received. The majority have albumin values within normal range 3.0 and 3.4 g/dl, with 118 patients (29.2%) followed by maximum number of patients with lower albumin level 2.5-3.0g/dl in 88 (21.7%).

Table.9: Distribution of vascular access in enrolled patients (N=673)

VASCULAR ACCESS	N (%)
Arteriovenous fistula	350 (52)
Non-tunneled catheter	161 (23.9)
Tunneled catheter	162 (24.1)

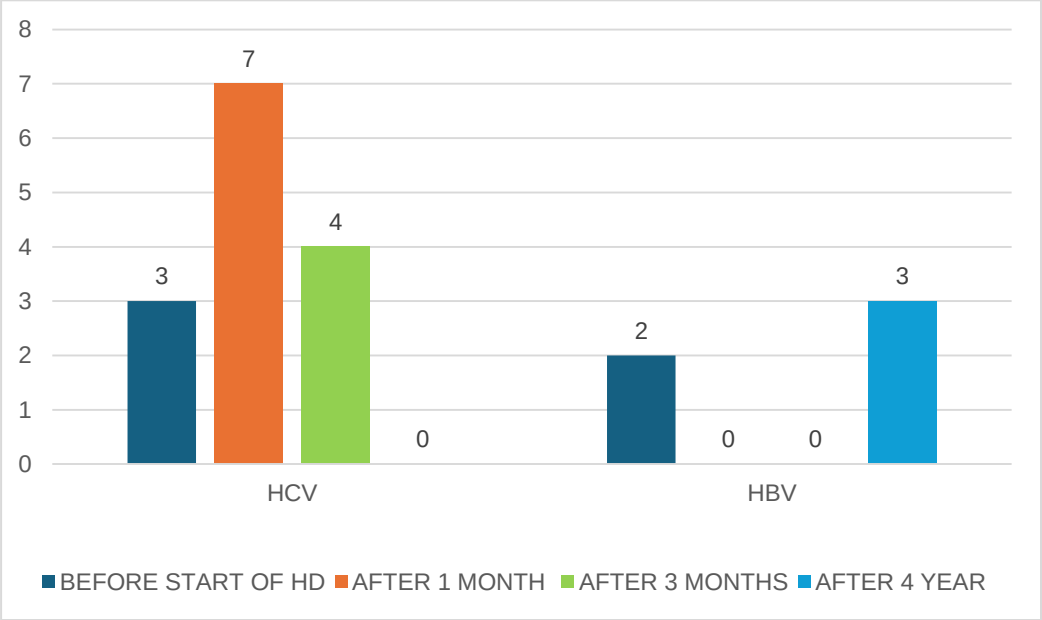
Among 673 patients, the most common type of vascular access was arteriovenous fistula 350 (52%) followed by tunneled 162 (24.1%), and non- tunneled catheters 161 (23.9%).

Table.10: Distribution of infections in enrolled patients (N=673)

TYPES OF INFECTIONS	N (%)
Bacterial	166 (24.7)
Viral	28 (4.2)
Fungal	25 (3.7)
Tubercular	7 (1.0)

Out of total 673 patients, 166 patients had bacterial infections followed by 28 patients had viral infections (3 HIV positive), (14 HCV positive), (5 HBV positive) and (6 Dengue positive). Additionally, in 25 patients, the most probable diagnosis was invasive fungal infection based on serological biomarkers and clinical suspicion and 7 patients were labelled tuberculosis on the basis of AFB smear and CBNAAT.

Figure 1: Seroconversion in Hepatitis seropositive patients (N=19)



- Out of total 28 patients, 19 patients had seroconversion during hemodialysis. Out of 14 patients,3 were already positive before the initiation of dialysis, in 7 seroconversion occur within 1 month of dialysis, and in 4 after 3 months of dialysis. HBV was positive in 2 patients before dialysis and 3 patients seroconverted after 4 years of dialysis.

Bacterial infections were further characterized on basis of demographic profile, clinical presentation, site of infection and to compare Hospital vs Community acquired infection.

Table.11: Sex distribution of patients with bacterial infections (N=166)

SEX	**N (%)**
Male	112 (67.5)
Female	54 (32.5)
Total	166

Male patients 112 (67.5%) have more bacterial infections as compared to female 54 (32.5%).

Table.12: Age wise distribution of patients with bacterial infections (N=166)

AGE GROUP	N (%)
20-30	8 (4.8)
31-40	10 (6)
41-50	23 (13.7)
51-60	46 (27.7)
61-70	61 (36.9)
>70	18 (10.9)
Total	166

Most affected age group was 61-70 (36.9%) followed by 51-60 (27.7%)

Table.13: Distribution of clinical symptoms in patients with bacterial infections (N=166)

SYMPTOMS	N (%)
Fever	162 (97.6)
Cough	119 (71.6)
Generalized weakness	72 (43.3)
Poor appetite	54 (32.5)
Pain in abdomen	34 (20.4)
Others	20 (12)
Weight gain	19 (11.4)
Breathlessness	16 (9.6)

Among 166 patient, fever was most common symptom (97.6%) followed by cough (71.6%).

Table.14: Distribution of comorbidity in patients with bacterial infection (N=166)

RISK FACTOR	N (%)
Hypertension	96 (57.8)
Diabetes mellitus	92 (55.4)
Cardiovascular disease	35 (21.1)

Among the 166 patients, the most prevalent comorbidity was hypertension 96 (57.8%) followed by diabetes mellitus 92(55.4%).

Table.15: Risk factors among patients with bacterial infections (N=166)

RISK FACTORS	N (%)
Anaemia	141 (84.9)
Hypotension	105 (63.2)
Fluid overload	101 (60.8)

Out of total, anaemia was the most prevalent risk factor (84.9%), followed by hypotension (63.2%) and fluid overload (60.8%).

Table.16: Duration of hemodialysis in patients with bacterial infections (N=166)

DURATION (months/years)	N (%)
0-3	56 (33.8)
3-6	12 (7.2)
6-12	36 (21.7)
1-2 years	23 (13.8)
2-3 years	23 (13.8)
3-4 years	12 (7.3)
>4 years	4 (2.4)

Maximum patients had duration of dialysis 0-3 months 56(33.8%), followed by 6-12 months 36 (21.7%)

Table.17: Distribution of dialysis frequency in patients with bacterial infection (N=166)

FREQUENCY	N (%)
Once weekly	39 (23.5)
Twice weekly	57 (34.3)
Thrice weekly	53 (31.9)
Irregular	17 (10.3)

Maximum number of patients had frequency of dialysis twice a week 57 (34.3%) followed thrice a week 53 (31.9%).

Table.18: Albumin values in patients with bacterial infections

ALBUMIN VALUES (g/dl)	N (%)
<2.5	28 (20)
2.5-3.0	35 (25)
3-3.4	40 (28.6)
3.5-3.9	30 (21.4)
>4	7 (5)

Out of 166 patients, 140 patients had done albumin levels, in rest of the patient requisition was not received. Maximum number of patients had albumin value within normal range 3-3.4g/dl in 40 (28.6%) patients, followed by low albumin value of 2.5-3.0g/dl in 35 (25%) patients.

Table.19: Distribution of vascular access in hemodialysis patients with bacterial infection (N=166)

VASCULAR ACCESS	N (%)
Arteriovenous fistula	60 (36.1)
Non-tunneled catheter	56 (33.7)
Tunneled catheter	50 (30.2)

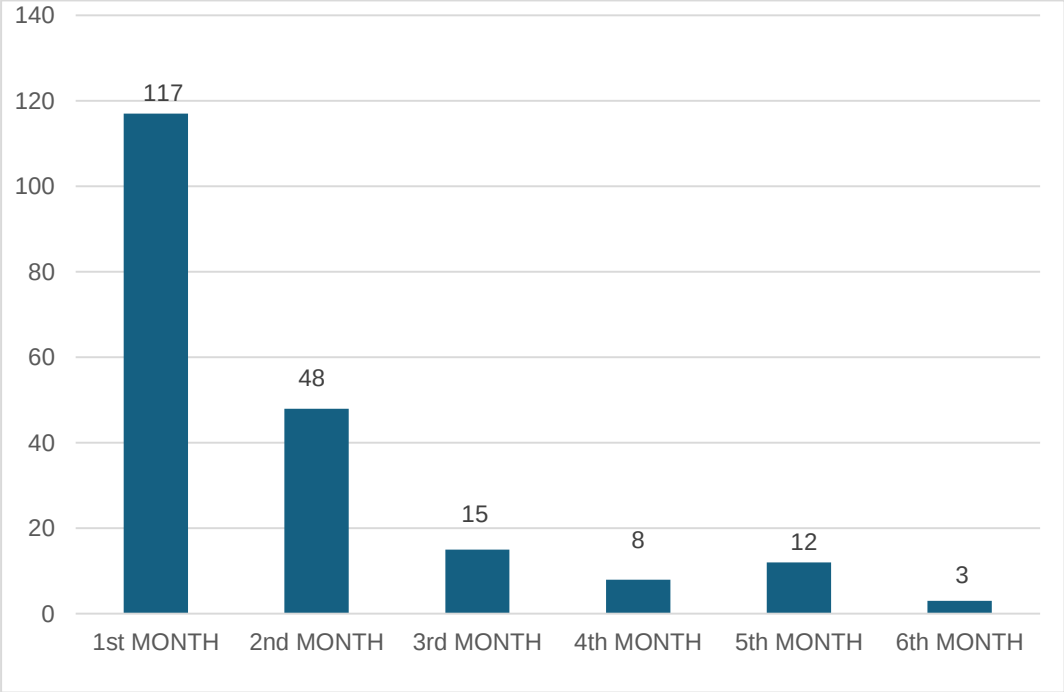
Among 166 patients with bacterial infection, the most common type of vascular access was arteriovenous fistula (36.1%), followed by non-tunneled (33.7%), and tunneled catheters (30.2%).

Table.20: Distribution of episodes in patients with bacterial infection

NUMBER OF PATIENTS	NUMBER OF EPISODE (%)
Single episode (135)	**135 (66.5)**
Multiple episode (31)	**68 (33.5)**
Two (27)	54 (26.6)
Three (3)	9 (4.4)
Five (1)	5 (2.5)
Total =166	203

In 166 patients, 203 episodes of infections were observed. In 135 patients (66.5%) single episode, while in 31patients 68 (33.5%) episode of infections were observed.

Figure.2: Distribution of bacterial infection episodes over 6 month of follow up (N = 203)



In this chart bacterial episodes were categorized over 6 months of follow up period and maximum number of episodes were observed in 1st month 117 of enrollment followed by second month in 48 patients.

In 202 patients Procalcitonin were received. Out of which 48 patient patients had PCT value of <0.5ng/ml and 154 patients had >0.5ng/ml.

Table.21: Site wise distribution of episodes of bacterial infections (N=203)

SINGLE SITE/ MULTIPLE SITE	N (%)
Single site	182 (89.6)
Multiple site	21 (10.4)

Out of the 203 episodes single site infections were seen in 182 (89.6%), while multiple-site infections were observed in 21 (10.4%)

Table.22: Distribution of single site bacterial infection (N=182)

TYPES OF INFECTION	N (%)
Urinary tract infection	99 (54.3)
Respiratory tract infection	32 (17.6)
Blood stream infection	20 (10.9)
Body fluid infection	19 (10.6)
Skin and soft tissue infection	12 (6.6)

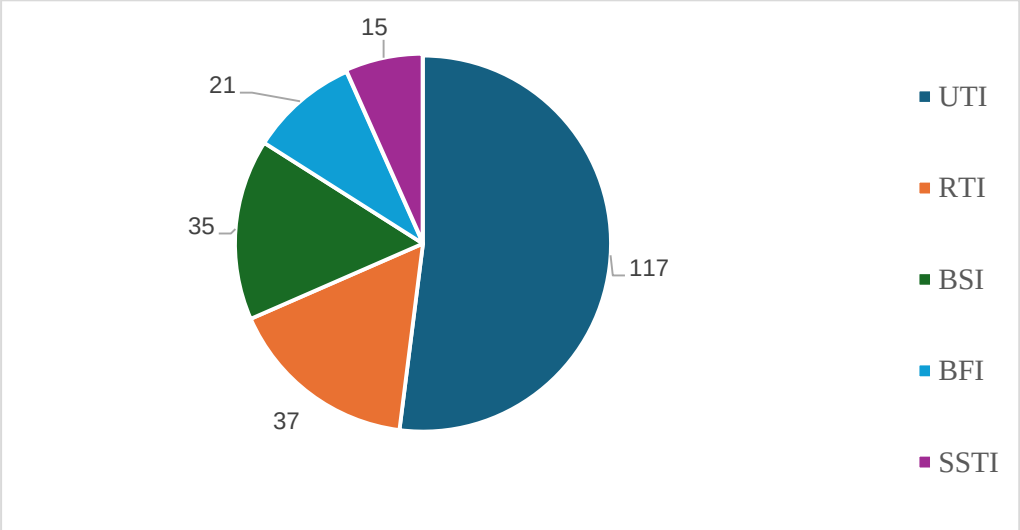
In single site bacterial infection, most predominant was urinary tract infection 99 (54.3%) followed by respiratory tract infection 32 (17.6%).

Table.23: Distribution of multiple site bacterial infections (N=21)

MULTIPLE SITE INFECTION	NUMBER	INFECTIONS
Urinary tract infection + Blood stream infection	12	24
Respiratory tract infection + urinary tract infection	3	6
Respiratory tract infection + Blood stream infection	2	4
Skin and soft tissue infection + Urinary tract infection	2	4
Body fluids infection + Urinary tract infection	1	2
Skin and soft tissue infection + Blood stream infection + Body fluid infection	1	3
Total	21	43

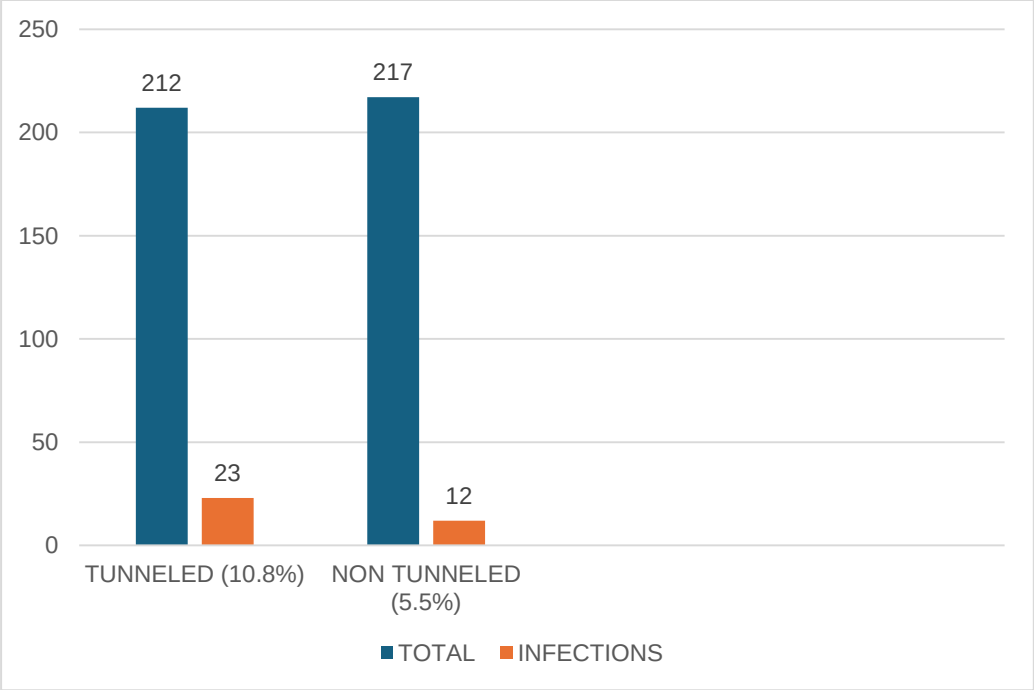
In total 21 episodes, 43 double and triple site infections were seen. So, a cumulative count of 225 bacterial infections were observed in combination of single and multiple site infection.

Figure:3 Distribution of bacterial infections (N= 225)



Most predominant infection was urinary tract infection (117), followed by respiratory tract infection (37) and blood stream infection (35).

Figure:4. Association of central-line related bloodstream infections in tunneled vs non-tunneled vascular access



Out of a total of 212 patients with tunneled catheters, 23 (10.8%) were associated with central line bloodstream infections. Among the 217 patients with non-tunneled catheters, only 12 (5.5%) patients had central line bloodstream infections.

Table.24: Comparison of infection in tunneled vs non-tunneled vascular access

	Infected N(%)	Not Infected N(%)	Total
Tunneled Catheters	23 (10.8)	189 (89.2)	212
Non-Tunneled Catheters	12 (5.5)	205 (94.5)	217
Total	35 (8.2)	394 (91.8)	429

Chi square statistic of 3.37 with a p-value of 0.066. This p-value indicates that there is not a statistically significant difference between the infection rates of tunneled and non-tunneled catheters at a typical alpha level of 0.05. Therefore, we fail to reject the null hypothesis that there is no association between catheter type and the incidence of infections.

Table.25: Distribution of monomicrobial/polymicrobial Bacterial infections

INFECTIONS	N (%)
Monomicrobial	208 (92.4)
Polymicrobial	17 (7.6)
Total	225 (100)

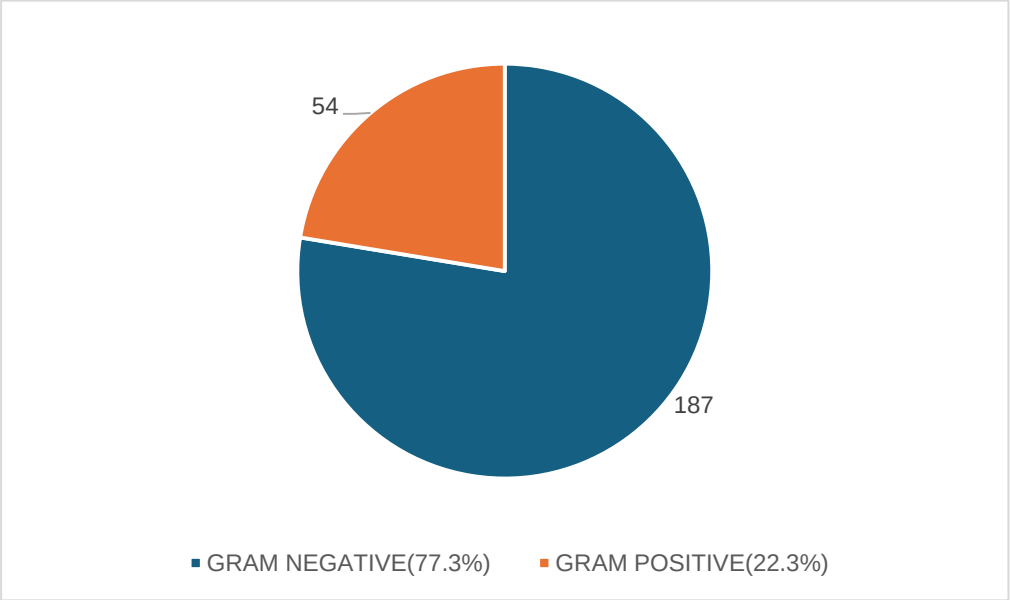
A total of 225 infections were observed among 166 patients, comprising of 208 (92.4%) monomicrobial and 17 (7.6%) were polymicrobial cases.

Table.26: Distribution of flora of poly-microbial infection

TYPE OF INFECTION	NUMBER
Urinary tract infection **(8)**	3
E.coli + P.aeruginosa	1
E.coli + P.aeruginosa	*1*
E.coli + A.baumannii	*1*
E.coli + P.mirabilis	*2*
K.pneumoniae + P.mirabilis	
Respiratory tract infection **(8)**	
K.pneumoniae + P.aeruginosa	3
K.pneumoniae + A.baumannii	3
A.baumannii + P.aeruginosa	1
E.coli + P.aeruginosa	1
Body fluids infection **(1)**	1
K.pneumoniae + P.aeruginosa	
Total = 17	34

Out of total 17 cases of polymicrobial infection 34 isolates were obtained Thus a total of 242 isolates (208 isolates from monomicrobial and 34 isolates from polymicrobial infections) were obtained

Figure:5. Distribution of isolates (N=242)



Majority of isolates were Gram negative (77.3%) as compared to Gram positive (22.3%).

Table.27: Distribution of organisms in patients with bacterial infection (N=242)

ORGANISM	UTI (N=125)	RTI (N=44)	BSI (N=35)	BFI (N=22)	SSTI (N=16)	TOTAL (N=242)
Gram Negative (N=187)	**N(%)**					
Klebsiella pneumoniae	37 (29.6)	19 (43.1)	8 (22.8)	1 (4.5)	3 (18.7)	68 (36.3)
Escherichia coli	43 (34.4)	6 (13.6)	5 (14.2)	3 (13.6)	3 (18.7)	60 (32)
Pseudomonas aeruginosa	14 (11.2)	7 (15.9)	3 (8.5)	3 (13.6)	-	27 (14.4)
Acinetobacter baumannii	2 (1.6)	9 (20.4)	1 (2.8)	3 (13.6)	-	15 (8)
Burkholderia cepacia	-	-	3 (8.5)	-	-	3 (1.6)
Proteus mirabilis	3 (2.4)	-	-	-	-	3 (1.6)
Enterobacter cloacae	1 (0.8)	-	1 (2.8)	-	-	2 (1)
Enterobacter aerogenes	1 (0.8)	1 (2.3)	-	-	-	2 (1)
Enterobacter gallinarum	1 (0.8)	-	-	-	-	1 (0.5)
Achromobacter xylosoxidans	-	-	2 (5.7)	-	-	2 (1)
Morganella morganii	-	-	-	-	1 (6.2)	1 (0.5)
Sphingomonas paucimobilis	-	-	-	1 (4.5)	-	1 (0.5)
Serratia liquefaciens	1 (0.8)	-	-	-	-	1 (0.5)
Citrobacter koseri	1 (0.8)	-	-	-	-	1 (0.5)
Gram Positive (n=55)						
Enterococcus faecium	14 (11.2)	1 (2.3)	1 (2.8)	2 (9)	1 (6.2)	19 (34.5)
Enterococcus faecalis	2 (1.6)	-	2 (5.75)	1 (4.5)	1 (6.2)	6 (10.9)
Staphylococcus aureus	1 (0.8)	-	3 (8.5)	2 (9)	3 (18.7)	9 (16.3)
Coagulase negative Staphylococci	4 (3.2)	1 (2.3)	6 (17.1)	6 (27.2)	4 (25)	21 (38.1)

Among Gram-negative isolates, *Klebsiella pneumoniae* was the most predominant (36.3%), followed by *Escherichia coli* (32%).

Among Gram-positive isolates, *Coagulase negative Staphylococci* (38.1%) and *Enterococcus faecium* (34.5%) were most common.

Figure:6 Flora of urinary tract infection (N=125)

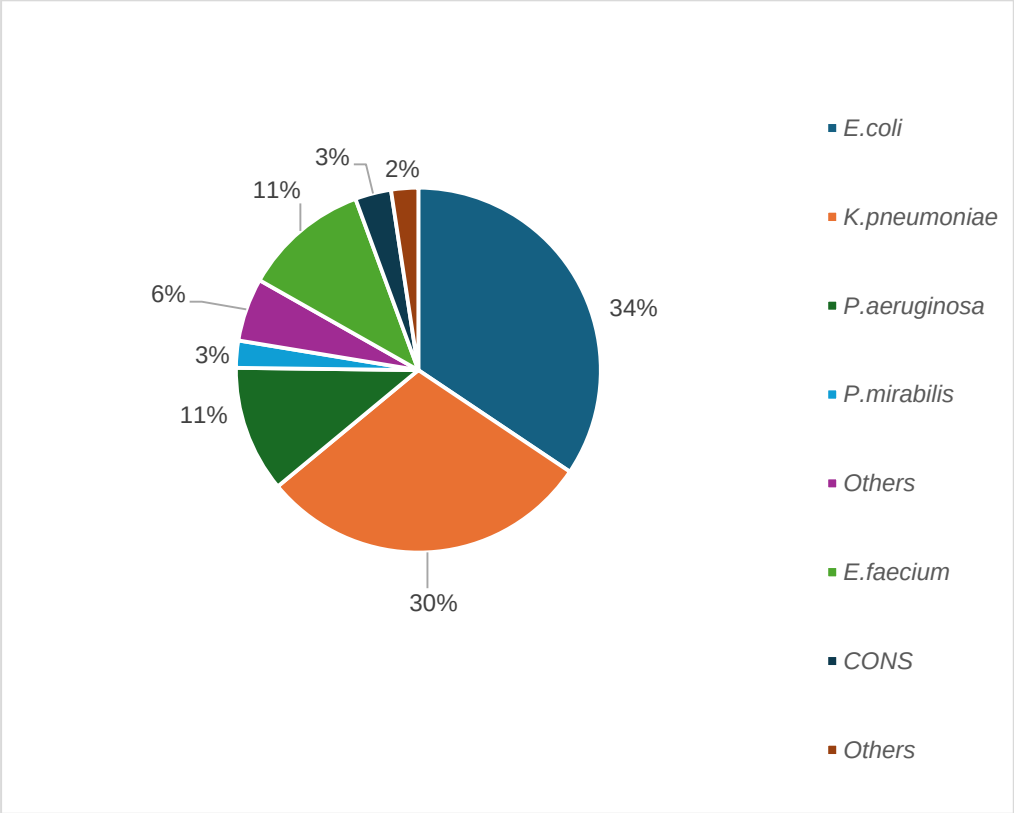


Figure: 7 Flora of respiratory tract infection (N=44)

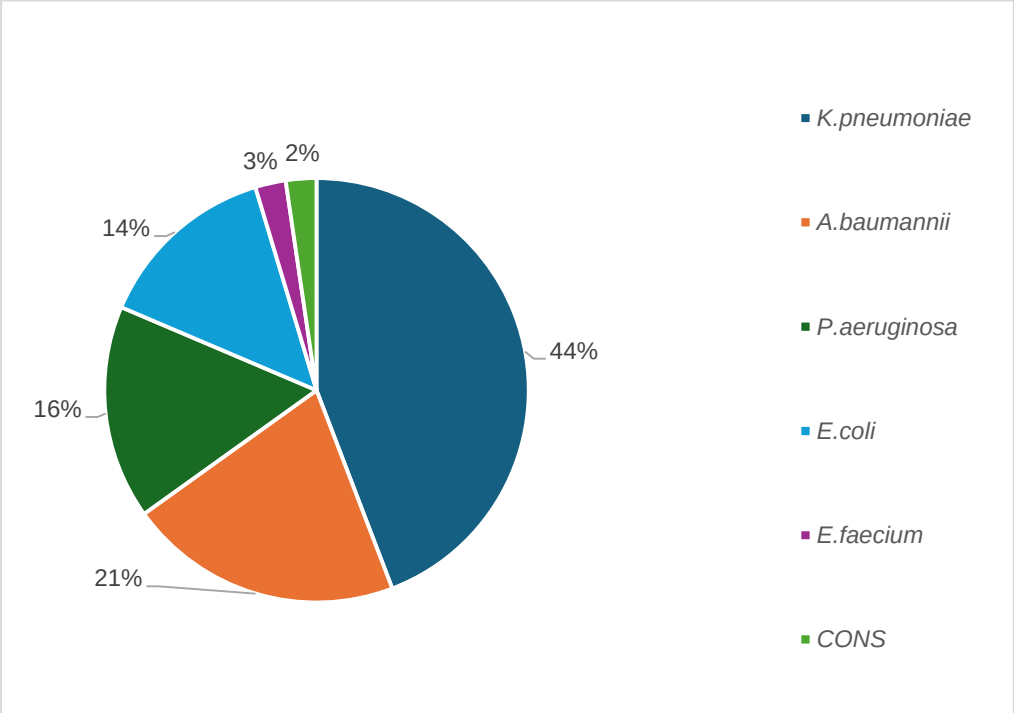


Figure: 8 Flora of blood stream infections (N=35)

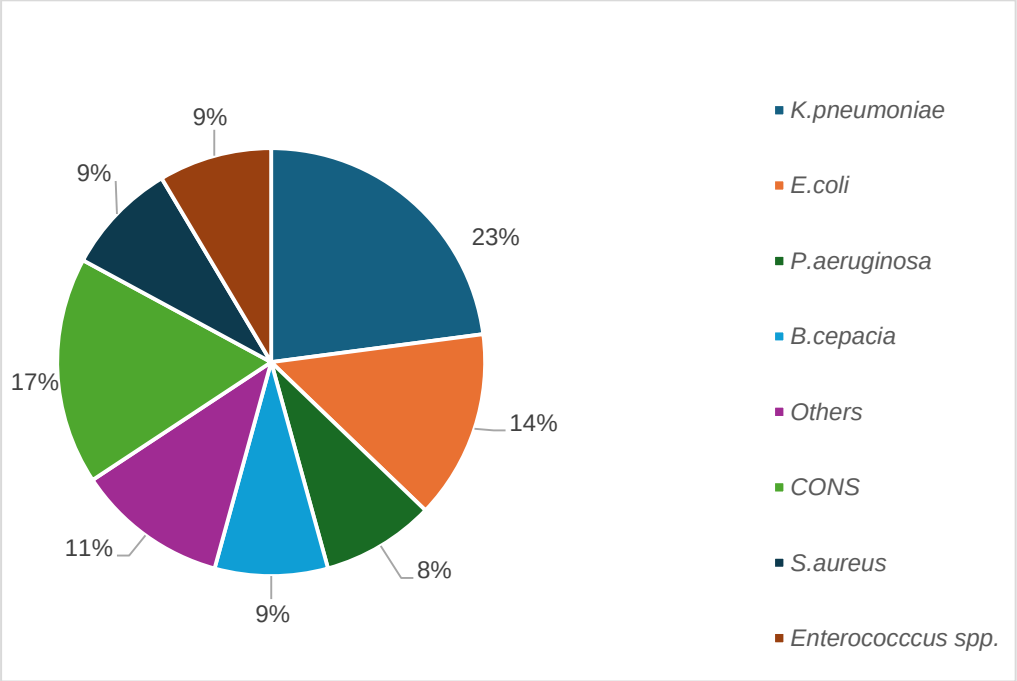


Figure: 9 Flora of bodyfluids infections (N=22)

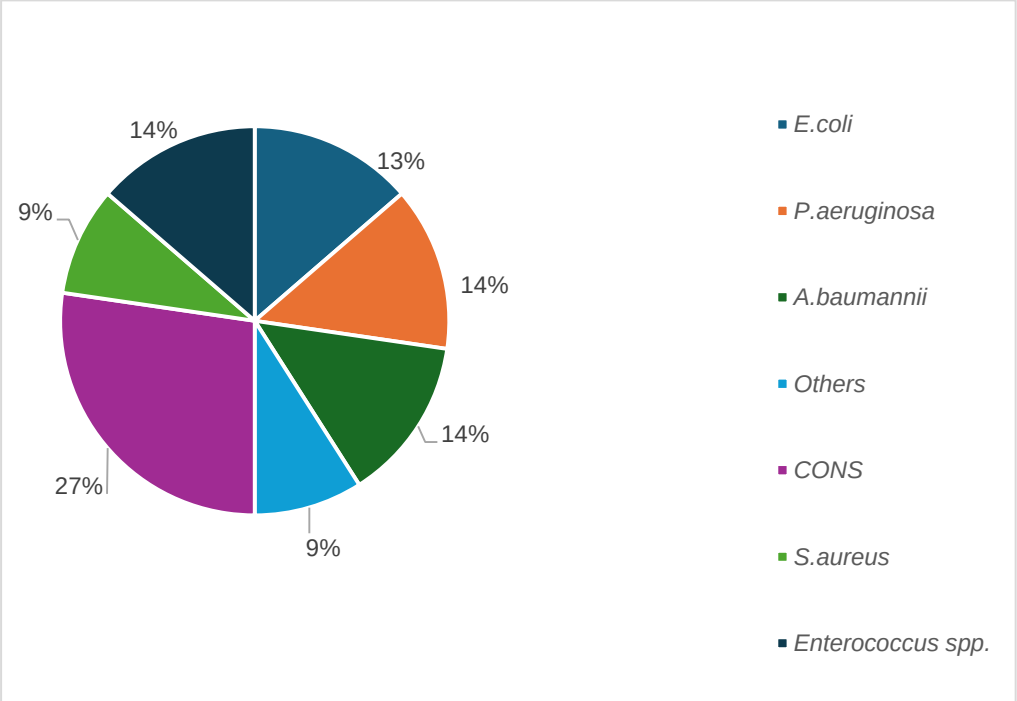


Figure:10 Flora of skin & soft tissue infection (N=16)

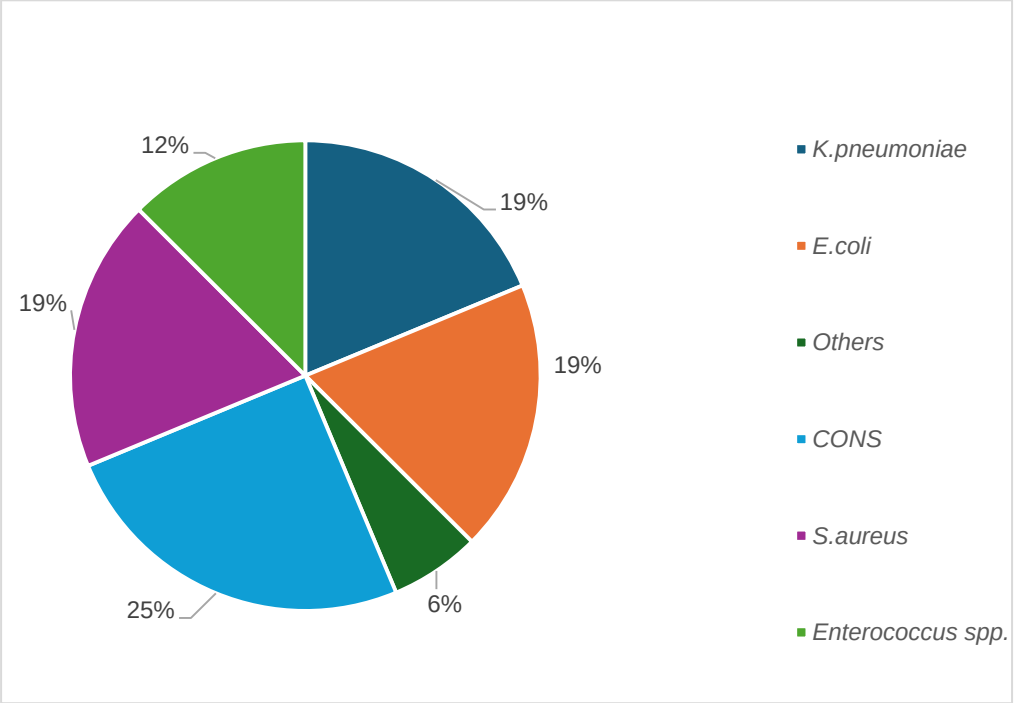


Table.28: Infection wise Antibiotic sensitivity profile of Gram-negative isolates.

	UTI (N=104)	RTI (N=42)	BSI (N=23)	BFI (N=11)	SSTI (N=7)
DRUGS	**N(%)**				
Amikacin	60 (57.6)	22 (53.3)	2 (8.7)	7 (63.6)	6 (85.7)
Gentamicin	55 (52.8)	17 (40.4)	15 (65.2)	3 (27.2)	6 (85.7)
Cotrimoxazole	40 (38.4)	15 (35.7)	12 (52.1)	3 (27.2)	6 (85.7)
Cefuroxime	-	10 (23.8)	3 (13)	-	5 (71.4)
Ceftriaxone	20 (19.2)	15 (35.7)	3 (13)	2 (18.1)	3 (42.8)
Cefixime	22 (21.1)	-	-	-	
Cefepime	-	15 (35.7)	10 (43.4)	3 (27.2)	2 (28.5)
Ciprofloxacin	19 (18.2)	7 (16.6)	1 (4.3)	2 (18.1)	7 (71.4)
Piperacillin +Tazobactam	61 (58.6)	18 (42.8)	7 (43.7)	4 (36.3)	3 (42.8)
Cefoperazone + sulbactum	52 (50)	25 (59.5)	12 (52.1)	5 (45.4)	3 (42.8)
Amoxycillin + clavulanic acid	25 (24.2)	10 (23.8)	11(47.8)	-	-
Imipenem	-	19 (45.2)	7 (43.4)	6 (54.5)	4 (57.1)
Ertapenem	45 (43.2)	19 (45.2)	9 (39.1)	-	2 (28.5)
Meropenem	-	21 (50)	9 (39.1)	6 (54.5)	5 (71.4)
Fosfomycin	90 (86.5)	-	-	-	-
Nitrofurantoin	67 (64.4)	-	-	-	-
Norfloxacin	25 (24)	-	-		-
Levofloxacin	-	-	-	3 (27.2)	-
Colistin	-	36 (85.7)	21 (91.3)	9 (81.8)	5 (71.4)
Tigecycline	-	23 (54.7)	-	-	4 (57.1)

In urinary tract infections. Gram-negative isolates, showed high susceptibility to Fosfomycin (86.5%), Nitrofurantoin (64.4%) and lowest susceptibility to Ciprofloxacin (18.2%), Ceftriaxone (19.2%), and Cefixime (21.1%)

In respiratory tract infections, high susceptibility was observed to Colistin (85.7%) and Cefoperazone + Sulbactam (59.5%) and low susceptibility showed to Ciprofloxacin (16.6%) and Cefuroxime (23.8%).

Blood isolates showed maximum susceptibility to Colistin (91.3%) and Gentamicin (65.2%), while low susceptibility was observed for Ciprofloxacin (4.3%) and Amikacin (8.7%).

Body fluid isolates exhibited maximum susceptibility to Colistin (81.8%) and Amikacin (63.6%) and low susceptibility to Ceftriaxone and Ciprofloxacin (18.1%).

In skin and soft tissue infections, high susceptibility noted with Amikacin, Gentamicin, and Cotrimoxazole (85.7%) and low susceptibility was showed to Cefepime and Ertapenem (28.5%).

Figure.11: Antibiotic susceptibility profile of Gram-negative isolates (N=187)

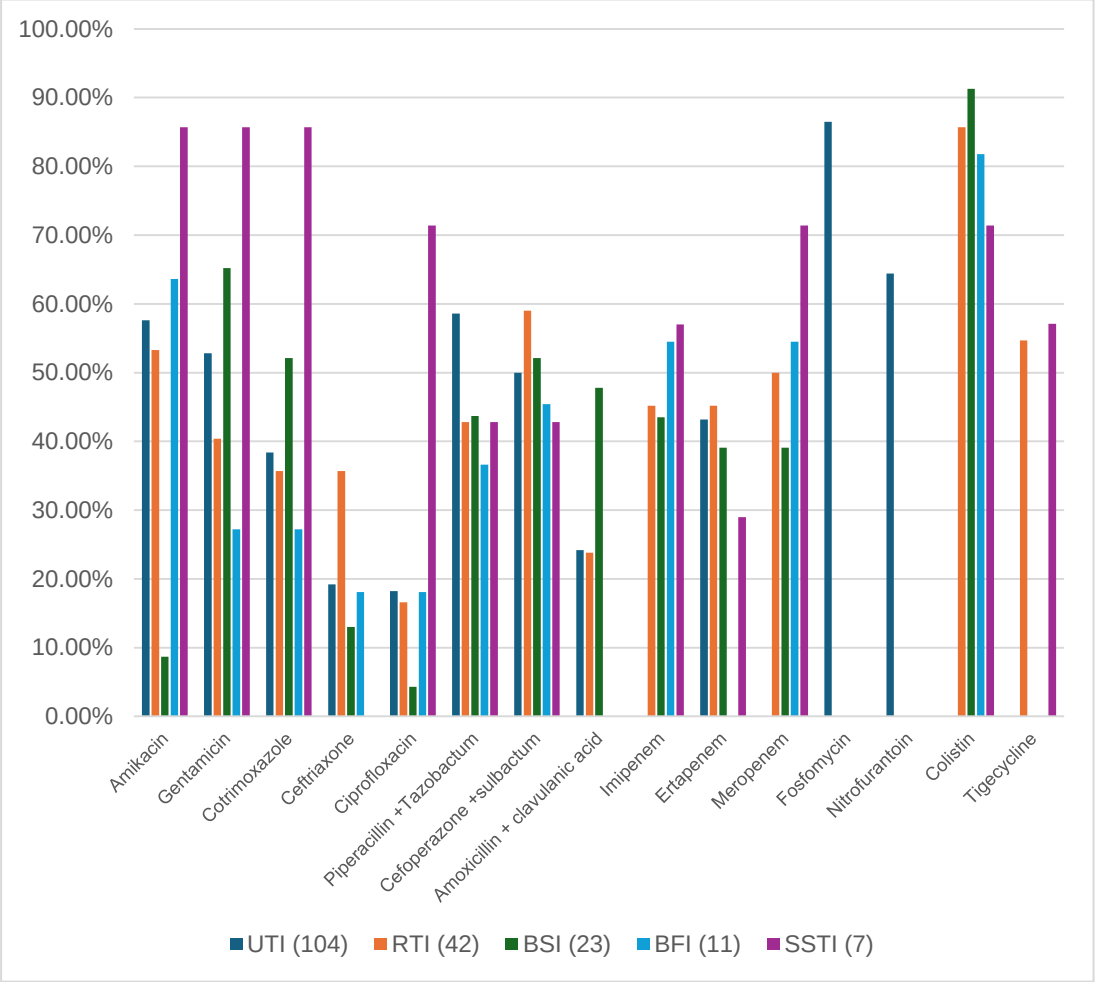


Table.29: Infection wise Antibiotic sensitivity profile of Gram-positive isolates.

	UTI (N=21)	BSI (N=12)	BFI (N=11)	SSTI (N=9)
DRUGS	**N(%)**			
Penicillin	8 (38.1)	2 (16.6)	2 (18.1)	2 (22.2)
Daptomycin	-	8 (66.6)	6 (54.5)	-
Gentamicin/(H)	7 (33.3)	7 (58.3)	4 (36.3)	9 (100)
Cotrimoxazole	12 (57.1)	7 (58.3)	7 (63.6)	4 (44.4)
Ciprofloxacin	2 (9.5)	2 (16.6)	2 (18.1)	4 (44.4)
Tetracycline	12 (57.1)	7 (58.3)	5 (45.4)	-
Erythromycin	-	3 (25)	1 (9)	5 (55.5)
Clindamycin	-	4 (33.3)	2 (18.1)	4 (44.4)
Linezolid	19 (90.4)	11 (91.6)	11 (100)	9 (100)
Vancomycin	12 (57.1)	10 (83.3)	11 (100)	9 (100)
Teicoplanin	12 (57.1)	11 (91.6)	11 (100)	9 (100)

Gram-positive isolates showed (100%) sensitivity to Linezolid and were susceptible to Vancomycin and Teicoplanin. Out of them 3 (33.3%) were Methicillin- resistant *Staphylococcus aureus*, 7 (35%) were Methicillin resistant *Coagulase negative Staphylococci* and 11 (25%) were Vancomycin resistant Enterococcus.

Figure.12: Antibiotic susceptibility profile of Gram positive isolates (N=55)

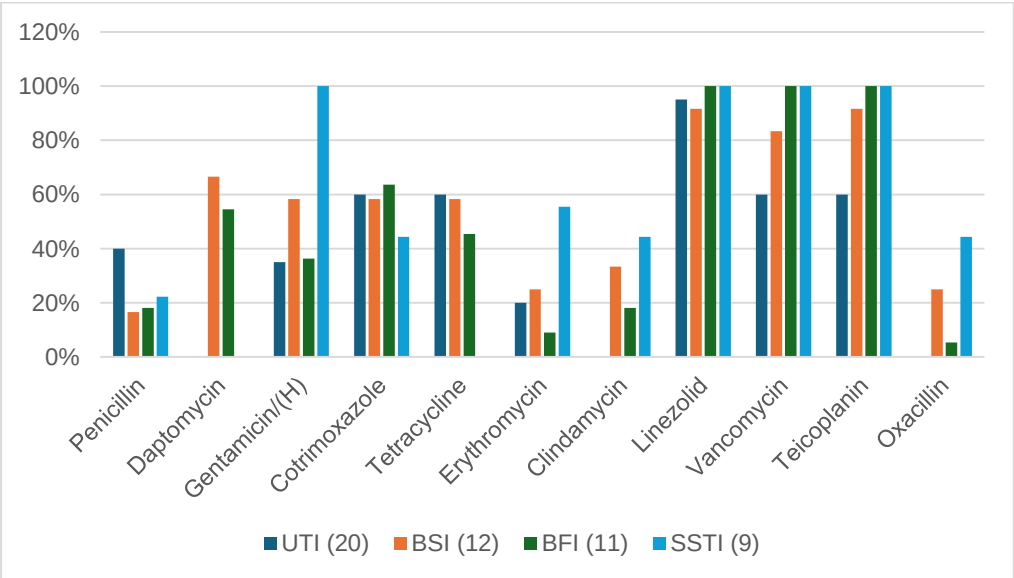


Table.30: Distribution of isolates on the basis of resistance

TYPE OF RESISTANCE	N (%)
Multi-drug resistant	200 (82.6)
Extensively drug resistant	180 (74.4)
Pan drug resistant	0 (0)

Maximum number of isolates were seen with multidrug resistant 200 (82.6%) followed by extensively drug resistant 180 (74.4%).

Table.31: Characterization of bacterial infections into Hospital vs Community acquired infections (n=225)

TYPE OF INFECTION	N (%)
Hospital acquired	105 (46.6)
Community acquired	120 (53.4)

Out of total, community-acquired infections were more common 120 (53.4%), as compared to hospital-acquired infections 105 (46.6%).

Table.32: Distribution of Hospital vs Community acquired bacterial infections (N=225)

TYPE OF INFECTION	HOSPITAL ACQUIRED (N=105)	COMMUNITY ACQUIRED (N=120)
	N(%)	
Urinary tract infection (117)	45 (42.8)	72 (60)
Respiratory tract infection (37)	14 (13.3)	23 (19.2)
Blood stream infection (35)	23 (21.90)	12 (10)
Body fluid infection (21)	13 (12.4)	8 (6.7)
Skin and soft tissue infection (16)	10 (9.6)	5 (4.1)

Urinary tract infection was most predominant in both hospital and community acquired infections (42.8% and 60% respectively), while second most common was blood stream infection (21.9%) in hospital acquired and respiratory tract infection (19.1%) in community acquired infections.

Table.33: Distribution of isolates in Hospital vs Community acquired bacterial infection (N=242)

ISOLATE (n=242)	**UTI (N=125)**		**RTI (N=44)**		**BSI (N=35)**		**BFI (N=22)**		**SSTI(N=16)**	
Gram negative (N=187)	**HA(80) N(%)**	**CA(45) N(%)**	**HA(23) N(%)**	**CA(21) N(%)**	**HA(29) N(%)**	**CA(6) N(%)**	**HA(14) N(%)**	**CA(8) N(%)**	**HA(10) N(%)**	**CA(6) N(%)**
K. pneumoniae	25 (31.2)	14 (31.1)	8 (34.7)	11 (52.3)	7 (24.1)	1 (16.6)	1 (7.1)	0 (0)	2 (20)	1 (16.6)
E.coli	30 (37.5)	13 (28.8)	2 (8.6)	4 (19)	4 (13.7)	1 (16.6)	1 (7.1)	2 (25)	1 (10)	2 (33.3)
P. aeruginosa	8 (10)	6 (13.3)	3 (13)	4 (19)	3 (10.3)	0 (0)	3 (21.4)	0 (0)	0 (0)	0 (0)
A. baumannii	2 (2.5)	0 (0)	9 (39.1)	0 (0)	1 (3.4)	0 (0)	3 (21.4)	0 (0)	0 (0)	0 (0)
Others	5 (6.2)	2 (4.4)	1 (4.3)	0 (0)	6 (20.6)	0 (0)	1 (7.1)	0 (0)	1 (10)	0 (0)
Gram positive (N=55)										
E. faecium	6 (7.5)	7 (15.5)	0 (0)	1 (4.7)	1 (3.4)	0 (0)	1 (7.1)	1 (12.5)	1 (10)	0 (0)
E.faecalis	2 (2.5)	0 (0)	0 (0)	0 (0)	2 (6.8)	0 (0)	1 (7.1)	0 (0)	1 (10)	0 (0)
S. aureus	1 (1.2)	0 (0)	0 (0)	0 (0)	3 (10.3)	0 (0)	2 (14.2)	0 (0)	3 (30)	0 (0
Coagulase-negative Staphylococci	1 (1.2)	3 (6.6)	0 (0)	1 (4.7)	2 (6.8)	4 (66.6)	1 (7.1)	5 (62.5)	1 (10)	3 (50)

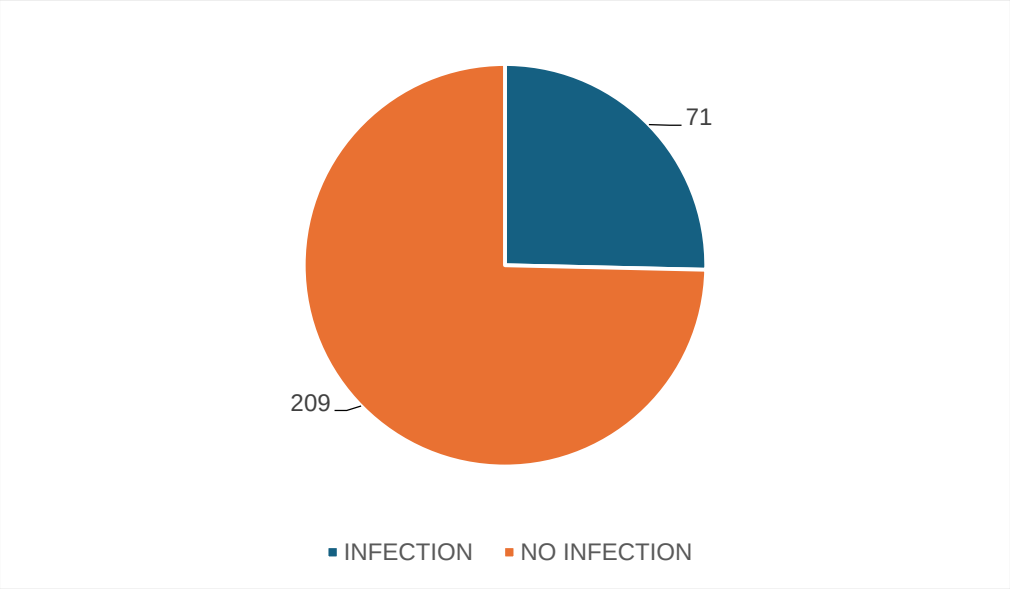
- *Escherichia coli*, and *Klebsiella pneumoniae* was predominant isolates among Hospital acquired and Community acquired.
- Most common pathogen causing respiratory tract infection was *Acinetobacter baumannii* (39.1%), in hospital acquired and *Klebsiella pneumoniae* (52.3%) in Community acquired.
- In Hospital acquired blood stream infections, *Klebsiella pneumoniae* (24.1%) was most common isolate and *Coagulase negative Staphylococci* (66.6%) was predominant in community acquired infections.
- Most common pathogens causing body-fluid infection were *Pseudomonas aeruginosa* and *Acinetobacter baumannii* (21.4%) in hospital acquired infection, and *Coagulase negative Staphylococci* (62.5%) in community acquired infection.
- Most common pathogen in skin and soft tissue infection was *Staphylococcus aureus* (30%) in hospital acquired infections and *Coagulase negative Staphylococci* (50%) in community acquired infection.

Table.34: Month wise lost to follow up enrolled patients

MONTH	PATIENT ENROLLED	2nd	3rd	4th	5th	6th
October	289	51	14	20	7	10
November	53	12	12	5	1	0
December	49	28	4	0	2	8
January	30	14	6	0	8	0
February	20	8	9	5	0	0
March	39	12	11	0	1	2
April	39	17	1	0	5	0
May	39	13	2	9	0	3
June	21	8	3	1	0	2
July	28	18	1	1	0	3
August	37	17	8	3	7	1
September	29	9	7	2	0	2
Total	**673**	**207**	**78**	**46**	**31**	**31**

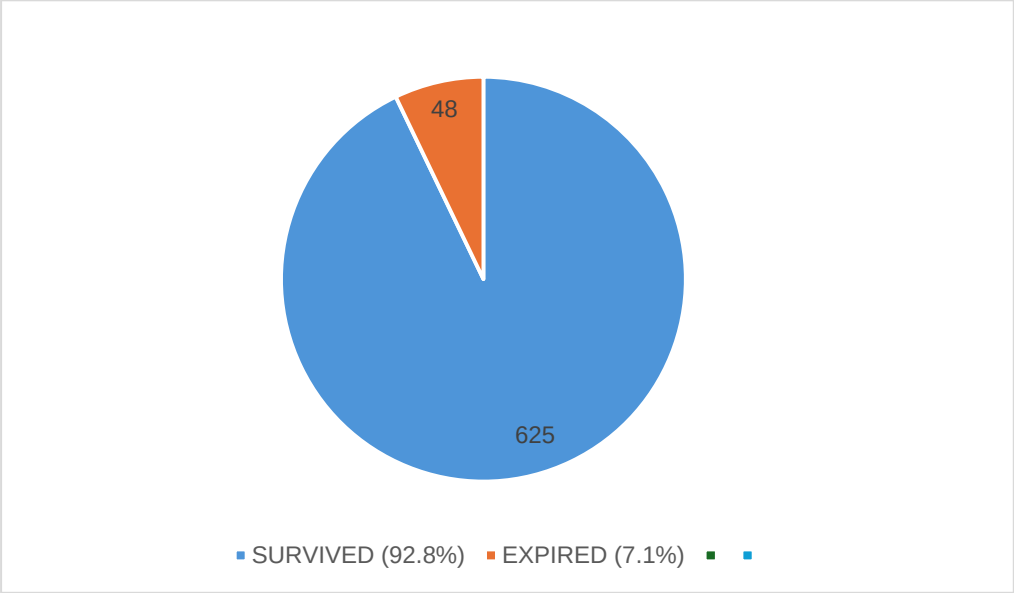
Out of 673 total number of patients, 280 patients had complete 6 month follow-up, 393 patients were lost to follow up, as they were shifted to another center or opted for transplant.

Figure 13: Distribution of infection in patients completed follow up (N=280)



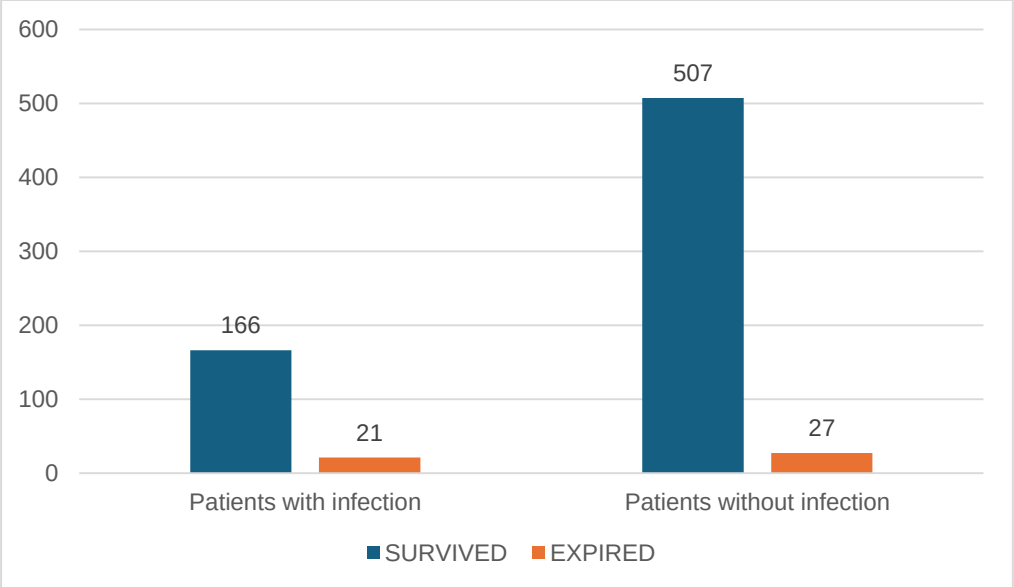
Out of 280 patients, 71 (25.4%) patients had infections and 209 (74.6%) were observed without infection.

Figure 14: Outcomes in enrolled patient (N=673)



In 673 enrolled patients, 48 (7.1%) patients were died.

Figure 15: Outcome in patients with and without infections (N=673)



Total 673 patients, 166 patients were observed with infections out of which 21 (12.6%) were expired and 507 patients had no infections among them 27 (5.3%) patients were expired.

Table.35: Comparison of various factors in patients with infection and without infection.

FACTORS	PATIENTS WITH INFECTION (n=166)	PATIENTS WITHOUT INFECTIONS (n=507)	P value	Significance
Age (mean)	57.41±12.5	54.86±14.2	0.01	Highly Significant
Sex (M/F)	112/54	347/160	0.89	Not Significant
Comorbidity				
Hypertension	120 (72.2%)	406 (80%)	0.01	HS
Diabetes mellitus	135 (81.3%)	340 (67%)	0.001	HS
Cardiovascular disease	33 (19.8%)	85 (16.7%)	0.036	HS
Risk factors				
Anaemia (Mean Hb – 8.29g/dl)	141 (84.9%)	426 (84%)	0.874	NS
Hypotension	105 (63.2%)	215 (42.4%)	0.001	HS
Fluid overload	101 (60.8%)	189 (37.2%)	0.001	HS
Albumin values (g/dl)	(n=140)	(n=264)		
<2.5	28 (20%)	39 (7.69%)	0.137	NS
2.5-3	35 (25%)	63 (12.4%)		
3-3.4	40 (28.5%)	64 (12.6%)		
3.5-3.9	30 (21.5%)	68 (13.4%)		
>4	7 (5%)	30 (5.9%)		
Duration of dialysis				
0-3 month	56 (33.7%)	138 (27.2%)	0.014	HS
3-6 month	12 (7.2%)	51 (10.5%)		
6-12 month	36 (21.7%)	63 (12.4%)		
1-2 years	23 (13.9%)	83 (16.1%)		
2-3 year	23 (13.9%)	105 (20.2%)		
3-4 year	12 (7.2%)	57 (11.7%)		
>4 year	4 (2.4%)	10 (1.9%)		
Frequency of dialysis				
Once weekly	39 (23.5%)	115 (22.6%)	0.457	NS
Twice weekly	57 (34.3%)	160 (31.5%)		
Thrice	53 (31.9%)	155 (30.6%)		
Irregular	17 (10.3%)	77 (15.3%)		
Vascular access				
Arteriovenous fistula	60 (36.1%)	210 (41.4%)	0.44	NS
Non tunneled catheter	56 (33.7%)	150 (29.6%)		
Tunneled catheter	50 (30.2%)	147 (29 %)		
Outcomes				
Transplanted	1 (0.6%)	5 (0.9%)	0.002	HS
Shifted outside	72 (45.3%)	267 (52.6%)		
Deaths	21 (12.6%)	27 (5.3%)		

Older patients were significantly (57.41) associated with high risk of infections. Diabetes mellitus (81.3%) showed more common in patients with infection, which was highly significant with risk of infection. Hypotension (63.2%) showed high significance with infections in infected patients.0-3 month of dialysis duration showed (33.7%) significance in patients with infection. Outcome of death (13.8%) was significantly higher in infected patients.

DISCUSSION

This prospective study was done in Dayanand Medical College & Hospital in Microbiology department over of period of one and half year on patients on maintenance hemodialysis. A total of 673 patients were enrolled and followed up for 6 month, out of them 226 patients were observed with various infections.

In this study out of 673 patients, majority were males (68%) as compared to females (32%), similar to study conducted by Dalgaard et al (62.8%)[65] and in contrast to study conducted in Taiwan (males=43.4% & females=56.6%) [3]. Majority of patients were in the age group of 61-70 years (30.1%) followed by 51-60 years (26.4%), in concordance with the study conducted in United States [26].

In this study most common clinical symptom was Generalized weakness present in(57.1%) of patients, in contrast to study conducted in Brazil, where most common clinical symptom was dizziness (74.5%)[66].

Out of 673 patients, majority of the patients were hypertensive (81.3%) followed by diabetes mellitus (67.4%), in contrast to study conducted by Wang et al, where diabetes mellitus (40.7%) was the most predominant co-morbidity [3].

The most common risk factor was anemia(96.7%), followed by hypotension(47.5%) whereas in study conducted in Washington, anemia(5%) was the least common risk factor [67].

In our study maximum number of patients receiving hemodialysis were within 0-3month (28.9%), in contrast to the study conducted in Denmark where majority of patients (38.2%) receiving dialysis more than one year [65].

Majority of the patients have albumin values with in normal range 3-3.5g/dl (29.2%), similar to the study by Michael et al[68].

In this study, most common vascular access was AV fistula (52%) followed by tunneled catheter (24.1%), similar to study conducted in Lebanon[20].

Majority of the patients with bacterial infections were male (67.5%) as compared to females (32.5%), whereas a study conducted in Birmingham, females were predominant(56.6%)[68]. Most common age group affected was 61-70 years(36.9%) similar to study done by Steven [69].

Most common symptom associated with bacterial infection was fever (97.6%), similar finding was reported by Jessica et al.[66]. Most prevalent comorbidity was hypertension(57.8%), in concordance with study done by Dayana et al.[19]

Anemia was most common risk factor among patients with bacterial infections similar to study by Shu hong et al.[67]

In 166 patients with bacterial infections, 203 episodes were observed with the rate of 5.7 episodes per 1000 per days of dialysis, similar was observed in study done at Hawaii.[69]

In 203 episodes of infection, 225 bacterial infections were observed out of which urinary tract infection (54.3%) was most common, whereas respiratory tract infection (32.7%) was reported by Ali et al.[20]

Out of 242 isolates, Gram negative isolates (77.3%) and Gram positive were (22.3%), similar findings in a study by Peter et al.[70]

In this study most predominant Gram negative isolates were *K.pneumoniae* (36.3%) followed by E.coli (32%), in contrast to study done at Ghana showed *A.baumannii* (17.6 %) followed by *P.aeruginosa* (11.8 %) were the most common Gram negative isolates.[70]

Most predominant Gram positive organism was *E.faecium* (34.5%) followed by *E.faecalis* (10.9%), in contrast to study done at tertiary hospital where *Cons* (20.6 %) and *S.aureus* (14.7 %) were the most common Gram positive organisms.[70]

This study observed most predominant isolate in central line associated bloodstream infection was *K.pneumoniae* (22.8%) and Cons (17.1%) in contrast to study done at Uttar pradesh where Cons (61.9%) and *A.baumanni* (11.9%) was reported. On antibiotic susceptibility profile Gram negative isolates showed maximum

sensitivity to Colistin (91.3%) and Cons were susceptibility to Linezolid (100%) , similar trend was exhibited by Abhilash et al.[71]

In this study (82%) isolates were multi-drug resistant, similar to the study by Edoh et al.(MDR=73.9%).[72]

In our study (33.3%) were MRSA, (35%) were MR-CONS in contrast to study to done by Edmond et al [73] where (29.3%) was MRSA and (80%) were MR-CONS**.** (11%) isolates were VRE , similar to study by Smout et al(VRE= 12.4%).[74]

Majority of infections were community acquired (53.3%) as compared to hospital acquired (46.6%). Most predominant were Gram negative isolates contributing in community acquired infection (50.8%), similar findings was reported in study at St. Francis Renal Institute, where (82%) infections were Community acquired caused by Gram negative (55%) isolates predominantly.[69]

In our study old age patients (61-70 years) were the contributing risk factor associated with mortality (p=0.01), similar findings were suggested by Rojas et al. Bloodstream infections were most common associating factor of infections in temporary catharized patients which is similar to study done by Sarnak et al.[21]

In our study mortality was observed in 48 (7.1%) patients and 625 (92.8%) patients survived which is lower as compared to the study done by Muhammad et al. (mortality rate =12.6%) [75].

In conclusion, this study on the profile of infections in end-stage renal disease (ESRD) patients on maintenance hemodialysis underscores the critical health challenges faced by this population. The findings reveal a high incidence of infections, primarily due to compromised immunity, frequent use of vascular access points, and prolonged hospital stays. These infections significantly impact patient morbidity and mortality, highlighting the urgent need for effective preventive measures and targeted treatments. This study contributes valuable insights into the types, prevalence, and outcomes of infections in hemodialysis patients, which can guide future research and inform clinical practices to enhance patient care and outcomes.

SUMMARY AND CONCLUSION

- This prospective study was done in Microbiology department in Dayanand Medical College and Hospital over a time period of 1.6 years.
- A total of 673 patients were enrolled.
- Majority of patients were males (68%) as compared females (32%).
- Most common age group affected were 61-70 years (30.1%)
- Most common clinical symptom in patients was generalized weakness (57.1%) followed by fever (53.9%) and cough (40.5%).
- The predominant comorbidity among hemodialysis patients was hypertension (81.3%) followed by diabetes mellitus (67.4%).
- The most common risk factor was anemia 651 (96.7%) followed by hypotension 320 (47.5%).
- Maximum number of patients receiving hemodialysis were within 0-3 months 195 (28.9%).
- The majority have albumin values within normal range 3.0 and 3.4 g/dl, with 118 patients (29.2%) followed by maximum number of patients with lower albumin level 2.5-3.0g/dl in 88 (21.7%).
- The most common type of vascular access was arteriovenous fistula 350 (52%) followed by tunneled 162 (24.1%), and non-tunneled catheters 161 (23.9%).
- Total number of infections were present in 226 patients with infection rate of 33.5%.out of which bacterial infections were(24.7%),viral (4.2%),fungal (3.7%) and tubercular infections were (1.0%). In viral infections majority of patients were HCV positive(2%).
- Majority of patient were males (67.5%). Most affected age group was 61-70 (36.9%) followed by 51-60 (27.7%)
- Fever was most common symptom (97.6%) followed by cough (71.6%). The most prevalent comorbidity was hypertension 96 (57.8%) followed by diabetes mellitus 92(55.4%) .Anemia was the most prevalent risk factor (84.9%), followed by hypotension (63.2%) and fluid overload (60.8%).

- Maximum patients had duration of dialysis 0-3 months 56(33.8%), followed by 6-12 months 36 (21.7%)
- The total of 203 episodes and 225 bacterial infections were observed.
- Most predominant infection was urinary tract infection (117), followed by respiratory tract infection (37) and blood stream infection (35).
- A total of 242 isolates were obtained, out of which 77.3% were Gram negative and 22.3% Gram positive.
- Among Gram-negative isolates, *Klebsiella pneumoniae* was the most predominant 68 (36.3%), followed by *Escherichia coli* 60 (32%). They showed maximum susceptibility to Amikacin, Gentamicin and to Cefoperazone +sulbactum.
- Among Gram-positive isolates, *Coagulase negative Staphylococci* 21 (38.1%) and Enterococcus facieum 19 (34.5%) were most common. All isolates were susceptible to Linezolid (100%) and showed maximum sensitivity to Vancomycin and Teicoplanin.
- Out of 242 isolates, 82.6% were multidrug resistant and 74.3% were extensively drug resistant.
- 53.3% infections were community acquired and 46.6% were hospital acquired. Urinary tract infection was most predominant in both hospital and community acquired infections (42.8% and 60%). *Escherichia coli* and *Klebsiella pneumoniae* was most predominant among hospital and community acquired infection.
- Out of 673 total number of patients, 280 patients had complete 6 month follow-up, 393 patients were lost to follow up, as they were shifted to another center or opted for transplant
- In 673 enrolled patients 48 (7.1%) were expired, 625 (92.8%) patients survived.

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IMAGES

Image 1: Hemofiltration dialysis machine

Image 2: Hemodialysis machine

Image 3: AV Fistula catheter

Image 4: Perma-catheter guide wire

Image 5: Blood culture bottles

Image 6: Bactec system

Image 7: BD Bactec system

MRD No. 1381365

Image 8: Blood agar showing golden yellow pigmented colonies

MRD No. 952603

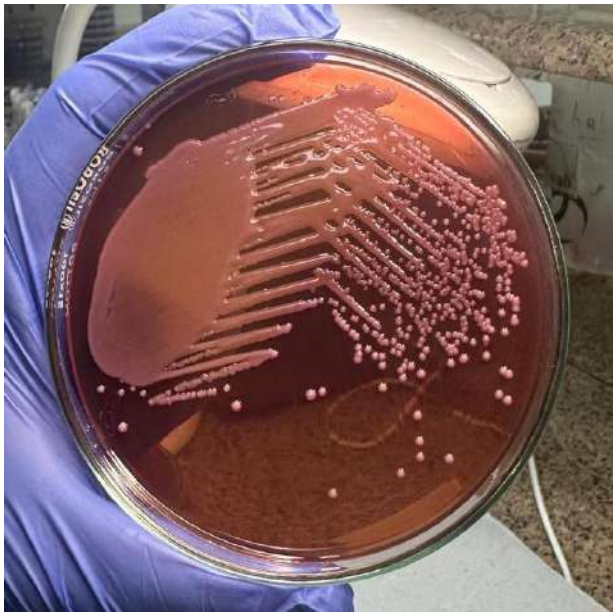

Image 9: MacConkey agar showing lactose fermenting colonies

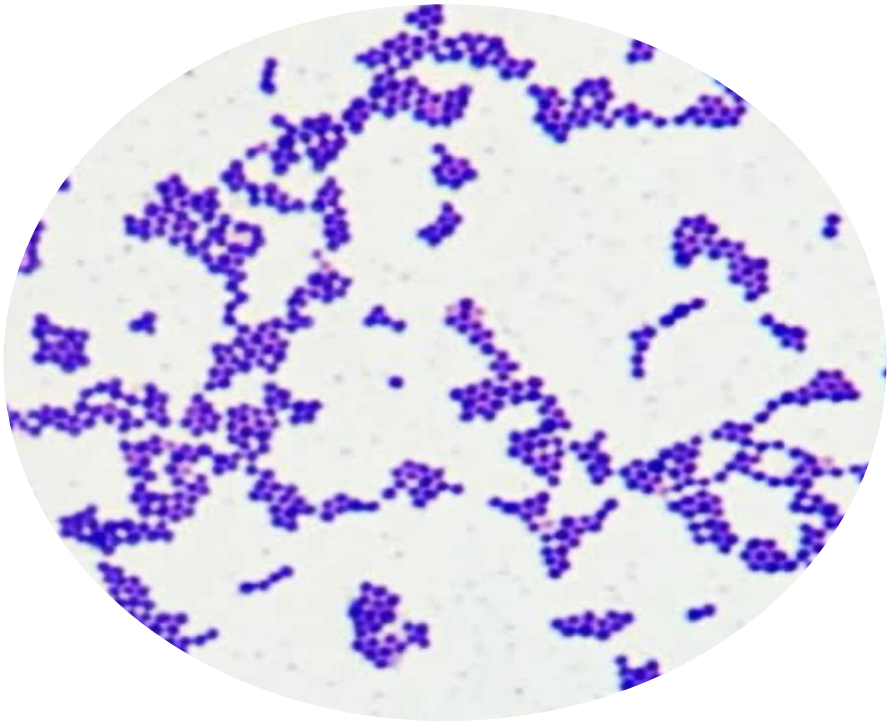

Image 10: Gram staining showing Gram positive cocci in cluster and pairs

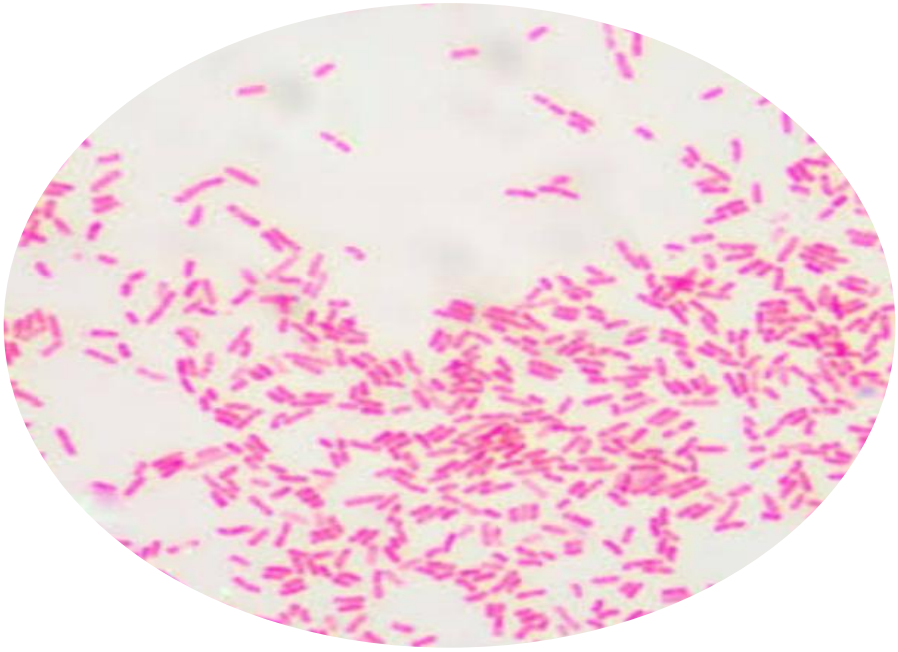

Image 11: Gram staining showing Gram negative bacilli

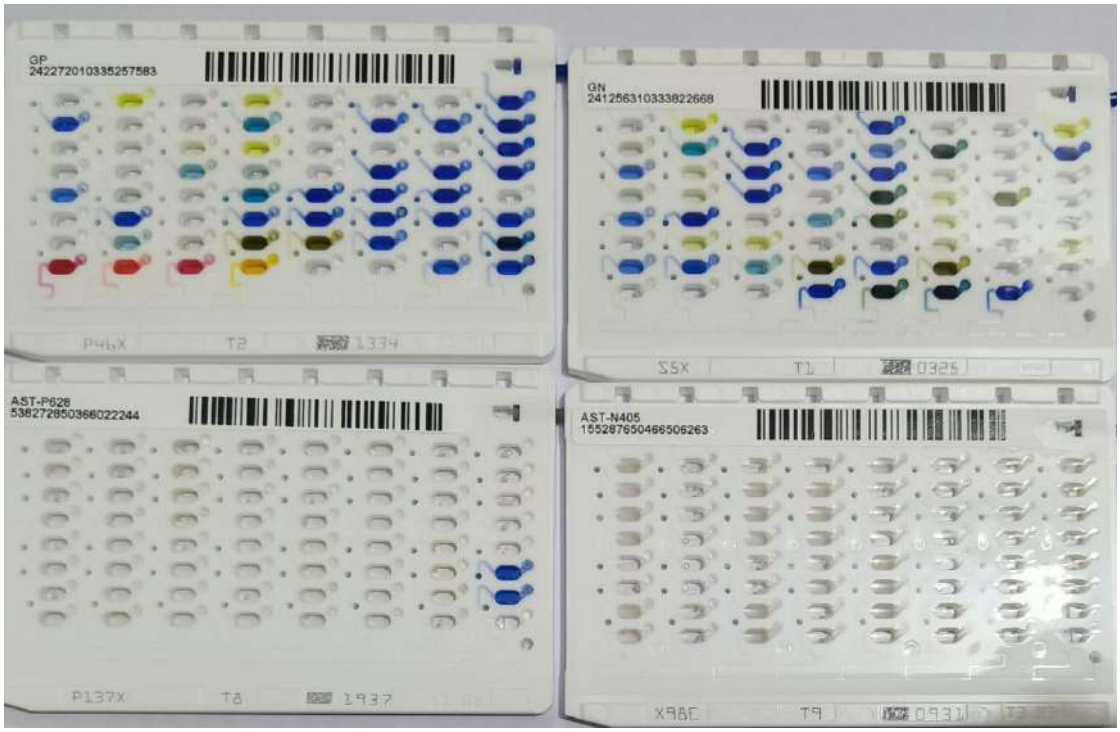

Image 12: Vitek 2 identification cards

Image 13: VITEK 2 system

MRD NO. 1478511

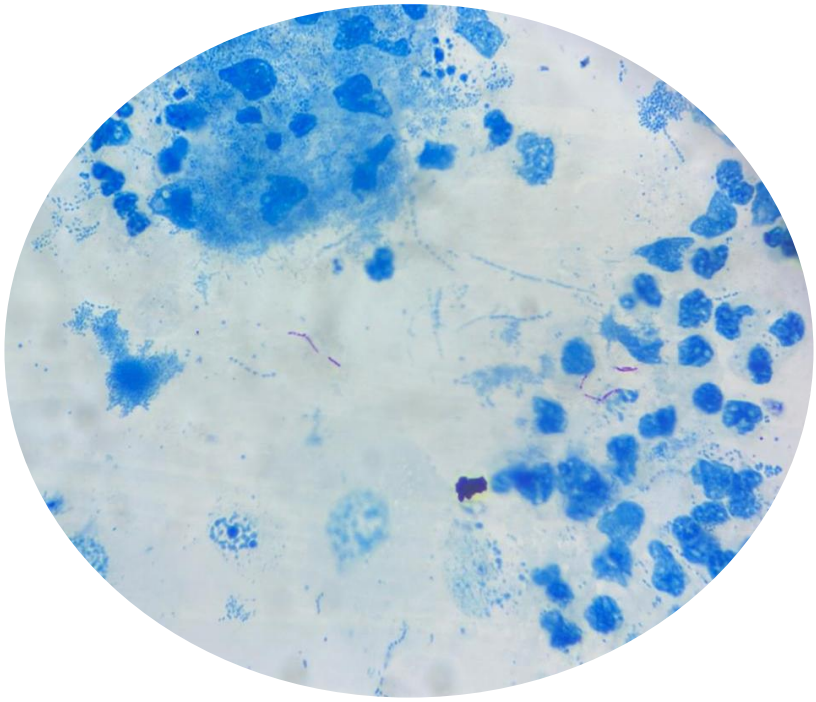

Image 14: ZN stain showing Acid fast bacilli

Image 15: GENE Xpert MTB/RIF ULTRA

Image 16: COBAS PURE e-402 (Viral marker)

Image 17: FACIS- AUTOMATION SYSTEM for fungal Biomarker

KEY TO MASTER CHART

KEYNOTE	FULL FORM
A	ABSENT
A/F	Ascitic fluid
BYLC	Budding yeast like cells
EICU	Emergency intensive care unit
EMG	Emergency
ENDO	Endocrinology ward
ET	Endotracheal tube
FW	Family ward
G-ICU	Gastro intensive care unit
GPC	Gram positive cocci
HDU	High dependency unit
IJV	Internal jugular vein catheter
LTP	Liver transplant unit
M-ICU	Medicine intensive care unit
MS	Moderate sensitive
NEG	Negative
NF	Normal flora
NG	No growth
NSG	No significant growth
P	Present
P/F	Pleural fluid
PCT	Procalcitonin
POS	Positive
R	Resistant
RPC	Renal parenchymal changes
S	Sensitive
SICU	Surgery intensive care unit
SPT	Sputum sample

| S.NO. | NAME | MRD NO | P value | INFECTION | AGE | SEX | ADMISSION NO. | DATE OF ADMISSION | CHIEF COMPLAINTS | | | | | | HIS. OF PRESENT ILLNESS | HD SESSIONS (NO OF TIMES IN 1 WEEK) | PAST HISTORY | | | | RISK FACTORS | | | | | | | INVESTIGATIONS | | | | | | | | | LABORATORY PARAMETERS | | | DIRECT MICROSCOPIC EXAMINATION | | | | | | | | |

| S.NO. | BACTERIAL CULTURE | | |

| S.NO. | Tobramycin | Chloramphenicol | Cefipime | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftaxidime+Avibactum | Erythromycin | Linezolid | Penicillin | Teicoplanin | Vancomycin | Gentamicin (high) | BLOOD CULTURE | Cotrimoxazole | Amikacin | Amoxiclav | Ceftriaxone | Ciprofloxacin | Gentamicin | Cefoperazone | Cefuroxime | Colistin | Ertapenem | Meropenem | Piperacillin | IMIPENAM | Cefipime | Levofloxacin | Aztreonam | Ceftazidime | Minocycline | Erythromycin | Linezolid | Nitrofurantoin | Penicillin | Teicoplanin | Tetracycline | Vancomycin | Gentamicin(high) | Doxycycline | Cefoxitin | Tobramycin | Chloramphenicol | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Clindamycin | Daptomycin | Oxacillin | FUNGAL CULTURE | SEROLOGICAL INVESTIGATION | MOLECULAR INVESTIGATION | | OTHER | | | | | FOLLOW UP | OUTCOME |
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| S.NO. | BACTERIAL CULTURE | | |

| S.NO. | Tobramycin | Chloramphenicol | Cefipime | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Erythromycin | Linezolid | Penicillin | Teicoplanin | Vancomycin | Gentamicin (high) | BLOOD CULTURE | Cotrimoxazole | Amikacin | Amoxiclav | Ceftriaxone | Ciprofloxacin | Gentamicin | Cefoperazone | Cefuroxime | Colistin | Ertapenem | Meropenem | Piperacillin | IMIPENAM | Cefipime | Levofloxacin | Aztreonam | Ceftazidime | Minocycline | Erythromycin | Linezolid | Nitrofurantoin | Penicillin | Teicoplanin | Tetracycline | Vancomycin | Gentamicin(high) | Doxycycline | Cefoxitin | Tobramycin | Chloramphenicol | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Clindamycin | Daptomycin | Oxacillin | FUNGAL CULTURE | SEROLOGICAL INVESTIGATION | MOLECULAR INVESTIGATION | | OTHER | | | | | FOLLOW UP | OUTCOME |
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| S.NO. | BACTERIAL CULTURE | | |

| S.NO. | Tobramycin | Chloramphenicol | Cefipime | Ampicillin+Sutbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Erythromycin | Linezolid | Penicillin | Teicoplanin | Vancomycin | Gentamicin (high) | BLOOD CULTURE | Cotrimoxazole | Amikacin | Amoxiclav | Ceftriaxone | Ciprofloxacin | Gentamicin | Cefoperazone | Cefuroxime | Colistin | Ertapenem | Meropenem | Piperacillin | IMIPENAM | Cefipime | Levofloxacin | Aztreonam | Ceftazidime | Minocycline | Erythromycin | Linezolid | Nitrofurantoin | Penicillin | Teicoplanin | Tetracycline | Vancomycin | Gentamicin(high) | Doxycycline | Cefoxitin | Tobramycin | Chloramphenicol | Ampicillin+Sabactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Clindamycin | Daptomycin | Oxacillin | FUNGAL CULTURE | SEROLOGICAL INVESTIGATION | MOLECULAR INVESTIGATION | | OTHER | | | | FOLLOW UP | OUTCOME |
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| S.NO. | BACTERIAL CULTURE | | |

S.NO.	Tobramycin	Chloramphenicol	Cefipime	Ampicill in+Sulbactum	Ceftalozane+Tazobactum	Ceftizoxime	Netilmicin	Ceftazidime+Avibactum	Erythromycin	Linezolid	Penicillin	Teicoplanin	Vancomycin	Gentamicin (high)	BLOOD CULTURE	Cotrimoxazole	Amikacin	Amoxiclav	Ceftriaxone	Ciprofloxacin	Gentamicin	Cefoperazone	Cefuroxime	Colistin	Ertapenem	Meropenem	Piperacillin	IMIPENAM	Cefipime	Levofloxacin	Aztreonam	Ceftazidime	Minocycline	Erythromycin	Linezolid	Nitrofurantoin	Penicillin	Teicoplanin	Tetracycline	Vancomycin	Gentamicin(high)	Doxycycline	Cefoxitin	Tobramycin	Chloramphenicol	Ampicillin+Sulbactum	Ceftalozane+Tazobactum	Ceftizoxime	Netilmicin	Ceftazidime+Avibactum	Clindamycin	Daptomycin	Oxacillin	FUNGAL CULTURE	SEROLOGICAL INVESTIGATION	MOLECULAR INVESTIGATION		OTHER				FOLLOW UP	OUTCOME
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| S.NO. | BACTERIAL CULTURE | | |

| S.NO. | Tobramycin | Chloramphenicol | Cefipime | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftaxidime+Avibactum | Erythromycin | Linezolid | Penicillin | Teicoplanin | Vancomycin | Gentamicin (high) | BLOOD CULTURE | Cotrimoxazole | Amikacin | Amoxiclav | Ceftriaxone | Ciprofloxacin | Gentamicin | Cefoperazone | Cefuroxime | Colistin | Ertapenem | Meropenem | Piperacillin | IMIPENAM | Cefipime | Levofloxacin | Aztreonam | Ceftazidime | Minocycline | Erythromycin | Linezolid | Nitrofurantoin | Penicillin | Teicoplanin | Tetracycline | Vancomycin | Gentamicin(high) | Doxycycline | Cefoxitin | Tobramycin | Chloramphenicol | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Clindamycin | Daptomycin | Oxacillin | FUNGAL CULTURE | SEROLOGICAL INVESTIGATION | MOLECULAR INVESTIGATION | | OTHER | | | | FOLLOW UP | OUTCOME |
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S.NO.	Tobramycin	Chloramphenicol	Cefipime	Ampicill in+Sulbactum	Ceftalozane+Tazobactum	Ceftizoxime	Netilmicin	Ceftazidime+Avibactum	Erythromycin	Linezolid	Penicillin	Teicoplanin	Vancomycin	Gentamicin (high)	BLOOD CULTURE	Cotrimoxazole	Amikacin	Amoxiclav	Ceftriaxone	Ciprofloxacin	Gentamicin	Cefoperazone	Cefuroxime	Colistin	Ertapenem	Meropenem	Piperacillin	IMIPENAM	Cefipime	Levofloxacin	Aztreonam	Ceftazidime	Minocycline	Erythromycin	Linezolid	Nitrofurantoin	Penicillin	Teicoplanin	Tetracycline	Vancomycin	Gentamicin(high)	Doxycycline	Cefoxitin	Tobramycin	Chloramphenicol	Ampicillin+Sulbactam	Ceftalozane+Tazobactum	Ceftizoxime	Netilmicin	Ceftazidime+Avibactum	Clindamycin	Daptomycin	Oxacillin	FUNGAL CULTURE	SEROLOGICAL INVESTIGATION	MOLECULAR INVESTIGATION		OTHER				FOLLOW UP	OUTCOME
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| S.NO. | BACTERIAL CULTURE | | |

| S.NO. | Tobramycin | Chloramphenicol | Cefipime | Ampicill in+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Erythromycin | Linezolid | Penicillin | Teicoplanin | Vancomycin | Gentamicin (high) | BLOOD CULTURE | Cotrimoxazole | Amikacin | Amoxiclav | Ceftriaxone | Ciprofloxacin | Gentamicin | Cefoperazone | Cefuroxime | Colistin | Ertapenem | Meropenem | Piperacillin | IMIPENAM | Cefipime | Levofloxacin | Aztreonam | Ceftazidime | Minocycline | Erythromycin | Linezolid | Nitrofurantoin | Penicillin | Teicoplanin | Tetracycline | Vancomycin | Gentamicin(high) | Doxycycline | Cefoxitin | Tobramycin | Chloramphenicol | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Clindamycin | Daptomycin | Oxacillin | FUNGAL CULTURE | SEROLOGICAL INVESTIGATION | MOLECULAR INVESTIGATION | | OTHER | | | | | FOLLOW UP | OUTCOME |
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S.NO.	Tobramycin	Chloramphenicol	Cefipime	Ampicillin+Sutbactum	Ceftalozane+Tazobactum	Ceftizoxime	Netilmicin	Ceftazidime+Avibactum	Erythromycin	Linezolid	Penicillin	Teicoplanin	Vancomycin	Gentamicin (high)	BLOOD CULTURE	Cotrimoxazole	Amikacin	Amoxiclav	Ceftriaxone	Ciprofloxacin	Gentamicin	Cefoperazone	Cefuroxime	Colistin	Ertapenem	Meropenem	Piperacillin	IMIPENAM	Cefipime	Levofloxacin	Aztreonam	Ceftazidime	Minocycline	Erythromycin	Linezolid	Nitrofurantoin	Penicillin	Teicoplanin	Tetracycline	Vancomycin	Gentamicin(high)	Doxycycline	Cefoxitin	Tobramycin	Chloramphenicol	Ampicillin+Sabactum	Ceftalozane+Tazobactum	Ceftizoxime	Netilmicin	Ceftazidime+Avibactum	Clindamycin	Daptomycin	Oxacillin	FUNGAL CULTURE	SEROLOGICAL INVESTIGATION	MOLECULAR INVESTIGATION		OTHER					FOLLOW UP	OUTCOME
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| S.NO. | Tobramycin | Chloramphenicol | Cefipime | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Erythromycin | Linezolid | Penicillin | Teicoplanin | Vancomycin | Gentamicin (high) | BLOOD CULTURE | Cotrimoxazole | Amikacin | Amoxiclav | Ceftriaxone | Ciprofloxacin | Gentamicin | Cefoperazone | Cefuroxime | Colistin | Ertapenem | Meropenem | Piperacillin | IMIPENAM | Cefipime | Levofloxacin | Aztreonam | Ceftazidime | Minocycline | Erythromycin | Linezolid | Nitrofurantoin | Penicillin | Teicoplanin | Tetracycline | Vancomycin | Gentamicin(high) | Doxycycline | Cefoxitin | Tobramycin | Chloramphenicol | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Clindamycin | Daptomycin | Oxacillin | FUNGAL CULTURE | SEROLOGICAL INVESTIGATION | MOLECULAR INVESTIGATION | | OTHER | | | | | FOLLOW UP | OUTCOME |
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S.NO.	Tobramycin	Chloramphenicol	Cefipime	Ampicillin+Sulbactum	Ceftalozane+Tazobactum	Ceftizoxime	Netilmicin	Ceftazidime+Avibactum	Erythromycin	Linezolid	Penicillin	Teicoplanin	Vancomycin	Gentamicin (high)	BLOOD CULTURE	Cotrimoxazole	Amikacin	Amoxiclav	Ceftriaxone	Ciprofloxacin	Gentamicin	Cefoperazone	Cefuroxime	Colistin	Ertapenem	Meropenem	Piperacillin	IMIPENAM	Cefipime	Levofloxacin	Aztreonam	Ceftazidime	Minocycline	Erythromycin	Linezolid	Nitrofurantoin	Penicillin	Teicoplanin	Tetracycline	Vancomycin	Gentamicin(high)	Doxycycline	Cefoxitin	Tobramycin	Chloramphenicol	Ampicillin+Sulbactum	Ceftalozane+Tazobactum	Ceftizoxime	Netilmicin	Ceftazidime+Avibactum	Clindamycin	Daptomycin	Oxacillin	FUNGAL CULTURE	SEROLOGICAL INVESTIGATION	MOLECULAR INVESTIGATION		OTHER					FOLLOW UP	OUTCOME
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| S.NO. | Tobramycin | Chloramphenicol | Cefipime | Ampicillin+Sutbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Erythromycin | Linezolid | Penicillin | Teicoplanin | Vancomycin | Gentamicin (high) | BLOOD CULTURE | Cotrimoxazole | Amikacin | Amoxiclav | Ceftriaxone | Ciprofloxacin | Gentamicin | Cefoperazone | Cefuroxime | Colistin | Ertapenem | Meropenem | Piperacillin | IMIPENAM | Cefipime | Levofloxacin | Aztreonam | Ceftazidime | Minocycline | Erythromycin | Linezolid | Nitrofurantoin | Penicillin | Teicoplanin | Tetracycline | Vancomycin | Gentamicin(high) | Doxycycline | Cefoxitin | Tobramycin | Chloramphenicol | Ampicillin+Sabactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Clindamycin | Daptomycin | Oxacillin | FUNGAL CULTURE | SEROLOGICAL INVESTIGATION | MOLECULAR INVESTIGATION | | OTHER | | | | | FOLLOW UP | OUTCOME |
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| S.NO. | NAME | MRD NO | P value | INFECTION | AGE | SEX | ADMISSION NO. | DATE OF ADMISSION | CHIEF COMPLAINTS | | | | | | HIS. OF PRESENT ILLNESS | HD SESSIONS (NO OF TIMES IN 1 WEEK) | PAST HISTORY | | | | RISK FACTORS | | | | | | | INVESTIGATIONS | | | | | | | | LABORATORY PARAMETERS | | | DIRECT MICROSCOPIC EXAMINATION | | | | | | | |

| S.NO. | BACTERIAL CULTURE | | |

| S.NO. | Tobramycin | Chloramphenicol | Cefipime | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Erythromycin | Linezolid | Penicillin | Teicoplanin | Vancomycin | Gentamicin (high) | BLOOD CULTURE | Cotrimoxazole | Amikacin | Amoxi clav | Ceftriaxone | Ciprofloxacin | Gentamicin | Cefoperazone | Cefuroxime | Colistin | Ertapenem | Meropenem | Piperacillin | IMIPENAM | Cefipime | Levofloxacin | Aztreonam | Ceftazidime | Minocycline | Erythromycin | Linezolid | Nitrofurantoin | Penicillin | Teicoplanin | Tetracycline | Vancomycin | Gentamicin(high) | Doxycycline | Cefoxitin | Tobramycin | Chloramphenicol | Ampicillin+Sulbactum | Ceftalozane+Tazobactum | Ceftizoxime | Netilmicin | Ceftazidime+Avibactum | Clindamycin | Daptomycin | Oxacillin | FUNGAL CULTURE | SEROLOGICAL INVESTIGATION | MOLECULAR INVESTIGATION | | OTHER | | | | | FOLLOW UP | OUTCOME |
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| S.NO. | NAME | MRD NO | P value | INFECTION | AGE | SEX | ADMISSION NO. | DATE OF ADMISSION | CHIEF COMPLAINTS | | | | | | HIS. OF PRESENT ILLNESS | HD SESSIONS (NO OF TIMES IN 1 WEEK) | PAST HISTORY | | | | RISK FACTORS | | | | | | | INVESTIGATIONS | | | | | | | | | LABORATORY PARAMETERS | | | DIRECT MICROSCOPIC EXAMINATION | | | | | | | | |

| S.NO. | BACTERIAL CULTURE | | |

S.NO.	Tobramycin	Chloramphenicol	Cefipime	Ampicillin+Sulbactum	Ceftalozane+Tazobactum	Ceftizoxime	Netilmicin	Ceftazidime+Avibactum	Erythromycin	Linezolid	Penicillin	Teicoplanin	Vancomycin	Gentamicin (high)	BLOOD CULTURE	Cotrimoxazole	Amikacin	Amoxiclav	Ceftriaxone	Ciprofloxacin	Gentamicin	Cefoperazone	Cefuroxime	Colistin	Ertapenem	Meropenem	Piperacillin	IMIPENAM	Cefipime	Levofloxacin	Aztreonam	Ceftazidime	Minocycline	Erythromycin	Linezolid	Nitrofurantoin	Penicillin	Teicoplanin	Tetracycline	Vancomycin	Gentamicin(high)	Doxycycline	Cefoxitin	Tobramycin	Chloramphenicol	Ampicillin+Sulbactum	Ceftalozane+Tazobactum	Ceftizoxime	Netilmicin	Ceftazidime+Avibactum	Clindamycin	Daptomycin	Oxacillin	FUNGAL CULTURE	SEROLOGICAL INVESTIGATION	MOLECULAR INVESTIGATION		OTHER					FOLLOW UP	OUTCOME
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Baba Farid University
of Health Sciences
Sadiq Road
Faridkot-151 203 (Pb). INDIA.
Phone : 01639-256232,256236
Tele/Fax : 01639-256235
Email – Thesisbfuhs@gmail.com

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No. BFUHS/2K23p-TH/ 21

Date 1/1/2024

The Principal
Dayanand Medical College & Hospital
Ludhiana

Subject:: Approval of Plan of Thesis.

This is to inform you that the Faculty of Medical Sciences in its meeting held on 25.09.2023 has approved the plan of thesis of **Sejshi Latvoshi**, a student of your college for **MD Microbiology** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis
To study profile of infections in patients of end stage renal disease on maintenance hemodialysis .

Supervisor
Dr. Veenu Gupta
Prof. & Head
Dept. of Microbiology

Co-Supervisor:-
Dr. Vikas Makkar
Prof. & Head.
Dept. of Nephrology

The student may submit the thesis in triplicate alongwith the plan in triplicate also, to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She may be directed to attach a photocopy of this letter with the forwarding letter while submitting thesis in the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic, if any.

Controller of Examinations

Note :

1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*

TO STUDY PROFILE OF INFECTIONS IN PATIENTS OF END STAGE RENAL DISEASE ON MAINTENANCE HEMODIALYSIS

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MD

In

MICROBIOLOGY

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES

FARIDKOT

AUGUST, 2022

DR. SEJSHI LATVOSHI

DEPARTMENT OF MICROBIOLOGY
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	TO STUDY PROFILE OF INFECTIONS IN PATIENTS OF END STAGE RENAL DISEASE ON MAINTENANCE HEMODIALYSIS
For the degree of	MD MICROBIOLOGY
Name of the candidate	Dr. Sejshi Latvoshi
Supervisor	Dr. Veenu Gupta, Professor& Head, Department of Microbiology, DMCH, Ludhiana
Co-Supervisor	Dr. Vikas Makkar, Professor& Head, Department of Nephrology, DMCH, Ludhiana
Institution	Dayanand Medical College and Hospital,Ludhiana
University	Baba Farid University of Health Sciences, Faridkot.

Introduction: Spectrum of infections are the leading cause of morbidity and mortality in hemodialysis patients. The risk of bacteremia is higher along with other infections like fungal,TB and blood transmitted viral infections. They are responsible for significant proportion of hospital admissions.

Aims and Objectives: To Characterize various infections in maintenance Hemodialysis patients of End stage renal disease..

Materials and Methods: The present prospective study which will be conducted over a period of one and half year. Enrollment of patients for one year and follow up of those patients for six months in the Department of Microbiology Dayanand Medical College and Hospital, Ludhiana. All the patients of End stage renal disease on maintenance Hemodialysis will be included in this study.

On the basis of clinical suspicion of infections in Hemodialysis patients various samples like Urine, Blood samples, Body fluids (CSF, Plueral fluid, Synovial fluid and Ascitic fluid), respiratory samples (ET, Bal, Sputum), Pus and stool received in department of microbiology will be cultured and processed according to standard protocols. Identification and Antimicrobial Susceptibilty of bacterial and fungal isolates will be done by BACTEC and VITEK I/D system. Samples for suspicion of TB are processed by ZN, LJ Medium, MGIT and by molecular method CBNAAT.

Clinical significance: Infections are an important cause for prolonged hospitalization, leading to increased treatment cost so this study was planned for early diagnosis and effective management of patients on maintenance hemodialysis and to study their prevalence, risk factors and outcomes.

Keywords: Hemodialysis, Bacteremia, Serology, Automated methods.

(Signature)	(Signature)	(Signature)	(Signature)
Candidate	Co-supervisor	Supervisor	Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"TO STUDY PROFILE OF INFECTIONS IN PATIENTS OF END STAGE RENAL DISEASE ON MAINTENANCE HEMODIALYSIS"** exist in the Department of Microbiology at Dayanand Medical College and Hospital, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis are genuine and is collected by the candidate herself under our supervision and guidance.

Supervisor

Dr. Veenu Gupta
Professor& Head
Department of Microbiology
DMCH, Ludhiana

Co-Supervisor's

Dr. Vikas Makkar
Professor & Head
Department of Nephrology
DMCH, Ludhiana

Head of the Department

Dr. Veenu Gupta
Professor & Head
Department of Microbiology
DMCH, Ludhiana

Place : LUDHIANA

Date : 20/09/22

APPROVAL PROFORMA
BY
RESEARCH & ETHICAL COMMITTEE
DAYANAND MEDICAL COLLEGE & HOSPITAL, LUDHIANA

Name of candidate	Dr. Sejshi Latvoshi
Department	Microbiology
Topic of Thesis	TO STUDY PROFILE OF INFECTIONS IN PATIENTS OF END STAGE RENAL DISEASE ON MAINTENANCE HEMODIALYSIS
Likely date of appearing in PG examination	May/ June,2024
Date of enrollment	7/03/2022
Name of Head of Department	Dr. Veenu Gupta
1) Supervisor **2) Co-Supervisor**	Dr. Veenu Gupta Dr. Vikas Makkar
Signature of Members of Research Committee with Stamp	**Signature of Members of Ethics Committee with Stamp**
Dr. Harpreet Kaur (Professor & Head, Pathology)	Mr. R K Sharma (Legal Expert)
Dr. Jaspal Singh (Professor & Head, Surgery)	Dr. RamitMahajan (Associate Professor, Gastroenterology)
Dr. Dinesh Gupta (Professor & Head, Medicine)	Dr. Anu Sharma (Professor, Anatomy)
Dr. Sandeep Kaushal (Dean Academics & Professor & Head, Pharmacology)	Dr. Sandeep Kaushal (Dean Academics & Professor & Head, Pharmacology)
Dr. Gurpreet S Wander (Vice Principal)	Dr. Gurpreet S Wander (Vice Principal & Professor & Head, Cardiology)
	Dr. Gagandeep Singh (Secretary, Ethics Committee Professor & Head, Neurology)

Approved: Yes / ~~No~~

Dr. Sandeep Puri
Chairperson
Research Committee

Chairperson
Research Committee

Approved: Yes / ~~No~~

Prof. Arvind Malhotra
Chairperson
Ethics Committee

Chairperson
Ethics Committee

BABA FARID UNIVERSITY OF HEALTH SCIENCES, FARIDKOT

PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

1	NAME OF THE CANDIDATE AND ADDRESS	DR. SEJSHI LATVOSHI PG Hostel, First floor, Room no. D-03 DMCH.
2	NAME OF THE INSTITUTE	Dayanand Medical College and Hospital, Ludhiana
3	COURSE OF STUDY AND SUBJECT	MD Microbiology
4	DATE OF ADMISSION OF COURSE	7th March, 2022.
5	TITLE OF THE TOPIC	To study profile of infections in patients of End stage Renal disease on maintenance Hemodialysis.

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Bacterial and Fungal infections are common cause of morbidity and mortality in haemodialysis patients.[1] They are responsible for a significant proportion of hospital admissions and total hospital days for patients with end stage renal disease.[2] Uremia is associated with immunodeficiency caused by functional abnormalities of neutrophils, reduced T& B cells function and impaired monocytes and monocytes derived dendritic cell function. Additionally, poor nutritional status, vitamin D Deficiency and Hyperparathyroidism in patients with chronic kidney disease contribute to impaired immunity.[3] The use of a hemodialysis catheter is a most important risk factor for bacteremia. Improvement of standard infection control measures, including the reduction of catheter use, appropriate catheter use, patient and staff education, and Hand Hygiene could reduce bacteremia in Hemodialysis patients.[4] Episodes of bacteremia and pneumonia account for majority of severe infections in this population.In addition to these bacterial infections another common problem in Hemodialysis units is the blood transmitted viral infections, particularly infections caused by Hepatitis B virus, Hepatitis C virus and Human immunodeficiency virus.[5] Another infection with particular characteristics in HEMODIALYSIS patients is Tuberculosis. The risk of active TB is increased in Hemodiaysis patients and often TB is expressed as Fever of unknown origin or is located extrapulmonary. Due to increased risk of latent TB activation in hemodialysis, CDC

recommends that patients should tested with Tuberculin skin test [5]. Although most common cause of bloodstream infections in this population is staphylococcus septicemia. Major cause of morbidity and mortality in patients undergoing hemodialysis is candidemia. Particularly C.glabrata and C.krusei in hemoialysis recipients.

So this study was planned for early diagnosis and effective management of spectrum of infections in patients on hemodialysis admitted in nephrology unit and to study their prevalence, risk factors and outcomes.

6.2 REVIEW OF LITERATURE

Infection is the second leading cause of death in Hemodialysis patients in many countries.Furthermore, infection is major cause of hospitalization in Hemodialysis patients. Hemodialysis patients have higher rates of bacteremia, whereas peritoneal dialysis patients have higher rates of peritonitis. In a study in United states, the rates(per 100 person- years) of specific infection- related hospitalization of hemodialysis patients were 17.6 for septicemia, 15.3 for pulmonary infections, 3.7 for gastrointestinal infections, 12.3 for genitourinary infections, and 10.2 for soft-tissue infections[4]. Half of ¾ of the causative organisms of bacteremia in hemodialysis patients are Gram-positive bacteria, remaining less than ¼ are Gram negative. Among the causative organisms, S.aureus (MRSA), is the most common causative organism. Other staphylococci, including S. epidermidis and coagulase negative staphylococcus, are also common Gram-positive organisms. E.Coli, Enterobacter species and klebsiella species are common Gram negative organisms isolated from blood samples. The pattern of causative organisms was similar in vascular access– associated and catheter – related bacteremia. Causes of bacteremia in hemodialysis patients in United States were infection/inflammation caused by internal prostheses (18%), other complications of internal prosthetic devices (8%), decubitus ulcer (6%), urinary tract infections (5%), pneumonia (5%), gangrene (3%), endocarditis (2%), and cellulitis and abscess of the foot. These data indicated that septicemia secondary to vascular access infections was the most common cause of septicemia

.[4] Similarly respiratory infection with particular characteristics in HEMODIALYSIS patients is Tuberculosis. This Mycobacterial infection is a great health problem since 8 million people develop active tuberculosis annually. The risk of active TB is increased in HEMODIALYSIS and often TB is expressed as fever of unknown origin. Due to increased risk of latent TB activation in HEMODIALYSIS, CDC recommends TUBERCULIN SKIN TEST. Test is considered positive if skin Induration is >5mm. In case of TST positivity preventive treatment with isoniazid alone or in combination with rifampicin is recommended. Unfortunately, TST sensitivity is limited in the hemodialysis population because of increased percentage of anergy (30-40%) to delayed hypersensitivity skin reactions. other method for diagnosis of TB in microbiology is molecular test CBNAAT [5]. Urinary tract infections clinical manifestations is affected by several factors eg; it depends upon severity of infection, part of urinary tract affected, the etiological organism and patient ability to mount a strong immune response. Common symptoms fever, chills,urinary urgency,dysuria and cloudy urine. Bacteria are considered most common cause of lower and upper urinary tract infections like E .coli, klebsiella, staphylococci, Enterobacter, proteus, pseudomonas and enterococci are more often isolated fromin patients [6]. One study included 100 hemodialysis – dependent end stage renal disease (50 men 50 women), The cause is diabetic nephropathy (37) patients, nephrosclerosis (19) patients, chronic glomerulonephritis (4) patients, IgA Nephropathy (3) patients and other (37) patients. Forty three patients had normosthenuria(ie,

nonpyuria and non bactereriuria). 31 patients had pyuria only, 0 patients had bacteriuria , and 26 patient had both pyuria and bacteriuria and these patients were diagnosed as having UTIs[7].

As well as known that patients undergoing dialysis treatment, are at increased risk for contracting viral infections. This is due to their underlying impaired cellular immunity, which increase their susceptibility to infections. Moreover hemodialysis patients may require blood transfusions, frequent hospitalization and surgery which increase opportunities for nosocomial infections exposure. The most frequent viral infections encountered in hemodialysis units are hepatitis B, hepatitis C, and to a lesser extent, human immunodeficiency virus infection.In dialysis unit patient to patient transmission of virus have been recognized since 1960s. Before the advent of vaccination, some success in limiting the spread of HBV was achieved by dialyzing seropositive patients separately from those who were seronegative[8].

WhereasCandidemia is major cause of morbidity and mortality in patients undergoing hemodialysis. Among 350 cases of candidemia, 78(22%) occurred in adult hemodialysis patients. Cases and controls were similar with respect to age, corticosteroid, antibiotic use, prevalence of diabetes mellitus. Multivariate analysis found total parenteral nutrition and dialysis through a vascular catheter (74%) to be independently associated with candidemia. Non candida albicans candida spp. Particularly C.glabrata and C. krusei were common in hemodialysis patients. Candidemia in hemodialysis recipients is

frequently caused by non – C.albicans candida spp. associated with TPN and dialysis via catheter (vs shunt or Fistula) and caries a higher mortality rate.Risk factors for candidemia case and controls were similar with respect to age, gender, receipt of corticosteroids, prevalence of diabetes mellitus, cancersetc. Those variables reaching statistical significance included dialysis through a catheter, TPN,antibiotic use and neutropenia and Antibiotic use, which was significant in univariate analysis,appeared not to be an independent risk factors for candidemia.as outcome in hospital mortality of cases was 40/77 (51.9%) compared with 113/283 (40%) for candidemic non-hemodialysis patients mortality was also significantly elevated for patients with candidemia receiving hemodialysis recipeints.[9] It has been estimated that the global prevalence of patients undergoing maintenance hemodialysis (HD) increased by 1.7 times from 165 patients per million population (pmp) in 1990 to 284 patients pmp in 1990 to 284 patients pmp in 2010.Chronic diseases, such as ESRD, limit daily activities and affect health-related quality of life (HRQoL) of patients[10]. Bacteremia in patients with ESRD may be under-ascertained in many general studies based on methodological criteria and infection classification. This is illustrated by a large multicentre study comparing incidence and risk factors for healthcare-associated bacteremia and community-acquired bacteremia.However, a significant proportion of Coagulase-Negative Staphylococcus Species CONS isolates likely represent true bacteremia rather than contamination in patients with ESRD and HD catheters. Even within the HD population,

there is significant variance in how Catheter Related Blood Stream Infection (CRBSI) is defined and reported in the literature [11]. Temporary vascular access by central venous catheter (CVC) is widely used in hemodialysis. However, CVC is associated with complications mainly infection. CVC related infection (CVC-RI) includes CVC related local infection (CVC-RLI) and CVC related bloodstream infection (CVC-RBI). CVC-RI and especially CVC-RBI is responsible for a considerable increase in health care costs, morbidity, and mortality. This is particularly true in patients with end stage renaldisease; sepsis is the second most common cause of death in this population after cardiovascular disease. The incidence of CVC-RBI ranges between 0.6 and 6.5 episodes per 1000 catheter-days Causative agents are mostly Staphylococcus aureus .. These risk factors vary from study to another. They include duration of CVC, diabetes mellitus, old age, and low hemoglobin and serum albumin levels [12]. To develop the most effective and efficient infection prevention strategies, it is important to better understand patient– and facility–level risk factors for infection-related hospitalization. The primary objective of our study was to identify patient characteristics and dialysis facility characteristics associated with the risk of infection-related Hospitalization.[13]

End-stage renal disease (ESRD) represents a serious public health problem fueled by aging populations and a pandemic of chronic non communicable diseases. Although overall mortality rate of the ESRD

population is improving, the mortality rate has been reported to be up to 30% within the first year of transition from CKD to ESRD. In particular, rapid progression of CKD is associated with worse clinical outcomes, such as cardiovascular events and death. To maintain daily life activities, renal replacement therapy is commonly used for ESRD in clinical practice, including hemodialysis, peritoneal dialysis, and kidney transplantation. Although kidney transplantation is the optimal choice of ESRD treatment, challenges such as immunosuppression and organ donor shortage remain an issue [14]. Therefore, ESRD necessitates management using dialysis to postpone imminent death. Among advanced CKD or ESRD treatment modalities, hemodialysis was found to be the primary approach of dialysis treatment for kidney failure, and around 90% of all patients undergoing dialysis received hemodialysis .According to a recent, nationwide cohort study.[14].

6.3 AIMS AND OBJECTIVES OF THE STUDY

- To characterize various infections in maintenance Hemodialysis patients of End stage renal disease.

7. MATERIALS AND METHODS

The present prospective study which will conducted over a period of one and half year. Enrollment of patient for one year and follow up of those patients for six months in the Department of Microbiology, DMCH & Hospital, Ludhiana. All then patients of End stage renal disease on maintenance hemodialysis will be included in this study.

7.1 Source of Data:

All samples received from patients on hemodialysis from Opd and Nephrology ward over a period one year in Dayanand Medical College and Hospital, Ludhiana will be included.

7.2 METHOD OF COLLECTION OF DATA

Inclusion Criteria:

a) Adult patients (>18 yrs) of End Stage Renal Disease on regular maintenance Hemodialysis.

Exclusion Criteria:

a) Pregnant women on Hemodialysis.

b) Patients with prior Kidney Transplant on Hemodialysis

c) Patients with Acute Kidney Injury.

Infections will be characterized and correlated with the clinical profile of patients on hemodialysis.

Patients details which includes Name, Age, Sex, MRD number, Date of admission, Risk factors old age/comorbidities/malnutrition/and

immunocompromised state),date of insertion of venous access/catheterized and removed. Source of admission, empirical antibiotics, general investigations, provisional diagnosis and outcome will be recorded in a proforma.

SAMPLE COLLECTION-

- ✓ **Urine** – Under all aseptic conditions urine samples from catheterized patients will be collected with a disposable syringe from the urine port.
- ✓ **Blood Samples: For culture:** Under all aseptic conditions, 10-20 ml of blood will be collected from antecubital vein with a disposable syringe and will be inoculated directly into commercially prepared BACTEC 9240/ BacT/Alert culture bottles**. For Serology:**2-3ml of blood will be taken and processed as per clinical requirement.
- ✓ **Body fluids :** Cerebrospinal fluid(CSF), pleural fluid, synovial fluid and ascitic fluid will be collected taking all aseptic precautions in sterile container.
- ✓ **Respiratory Samples :(ET, BAL, SPUTUM)** will be collected under aseptic conditions.
- ✓ **Pus**: Under all aseptic conditions these samples will be collected in sterile universal container.
- ✓ **Stool:** It will be collected in sterile clean wide mouthed container without contamination with urine, water, and disinfectants.

SAMPLE PROCESSING: Various samples received in Microbiology laboratory will be processed as per standard protocols.

DIRECT MICROSCOPIC EXAMINATION: As Per Clinical suspicion

- Gram Staining will be performed from samples.
- KOH mount – 20% KOH will be used for identification of fungal elements.
- ZN staining-Smear will be prepared for detection of acid fast bacilli.
- For CSF(Cerebrospinal fluid)- Wet mount preparation, India ink preparation, Bacterial Antigen and Cryptococcal Antigen will be done.
- For STOOL- Stool Routine Examination to check pus cells, RBCs & for ova, cyst& trophozoites. Stool for occult Blood / Stool smear for Cryptosporidium and for GDH for Clostridium Difficile,Toxin A &B(Glutamate Dehydrogenase) will be done.

- **BACTERIAL CULTURE**: Blood and body fluids specimens will be processed in BACTEC 9240 or BacT/Alert microbial detection system. Blood culture bottles will be loaded in the instrument and incubated for a maximum period of 7 days or bottle indicated positive by the system a time to positivity will be noted.

Smears will be prepared from positive blood cultures bottles and Gram staining will be done. The positive bottle be subcultured on Blood agar or MacConkey agar plates.

- Urine, Respiratory samples, Pus, swabs, Sputum etc. will be cultured on Blood and MacConkey Agar and incubated at 37*C for 24-48hrs.

Identification and AST (antibiotic sensitivity testing) of the isolates will be done by VITEK 2 system.

- **STOOL CULTURE**:

Samples will be processed on MacConkey, DCA and Congo red Agar within 2 hours of receiving. After 24 hours of incubation growth will be identified from colonies. Then Biochemical test will be performed for identification and AST will be done accordingly.

MYCOBACTERIALCULTURE:

After decontamination/centrifugation/homogenization, samples will be cultured on LJ medium/MGIT and Incubated for 6-8 weeks. Growth obtained will be identified through ZN smear to confirm acid fast bacilli.

FUNGAL CULTURE- Samples will be cultured on 2 sets of Sabourauds dextrose agar (with and without cycloheximide) and incubated at 25*C and 37*C for 21 days. Fungal growth obtained will be identified on basis of colony morphology, rate of growth, colour, texture and pigmentation. Identified as Yeast or molds. For further identification Yeast will be identified by Germ tube test(GTT) and similarly for molds identification Lactophenol cotton blue mount(LCB) will be prepared.

SEROLOGICAL TESTING (will be done as per request): For HBsAg antigen, AntiHCV, AntiHIV, 1-3B-DGlucan Assay, Aspergillus Galactomannan, Leptospira IgM , Scrub Typhus IgM, Dengue IgM and NS1 Ag, CMV IgG & IgM and PCT will be processed as per kit protocols.

MOLECULAR TESTING:-As per clinical suspicion the molecular test which can be done are HBV DNA, HCV RNA, CBNAAT/LPA and BIOFIRE FILM ARRAY.

OUTCOME

Patients condition improved or worsened will be notified in the study.

STATISTICAL ANALYSIS

Data will be described in terms of range; mean ±standard deviations (±SD) frequencies (number of cases) and relative frequencies (%age) as appropriate. All statistical calculations will be done usingSPSS(statistical package for the social sciences). SPSS 21 version statistical program for Microsoft windows.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

No

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Attached herewith

8. LIST OF REFERENCES

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PROFORMA

SR. NO:

NAME: DATE OF ADMISSION:

MRD NO: AREA:

ADMISSION NO:

CHIEF COMPLAINTS:

ETIOLOGY OF KIDNEY DISEASE:

HISTORY OF PRESENT ILLNESS:

PAST HISTORY/DURATION:

HAEMODIALYSIS DURATION/FREQUENCY/PLACE:

RISK FACTORS:

1.Hypertension:

2.Uncontrolled Diabetes:

3.Fluid Overload:

4.CVD:

5.Urinary catheterization:

6.Vascular access:

7.Corticosteroid use:

8.:Others:

Signature of Candidate **Signature of Supervisor**

INVESTIGATIONS: HEMOGRAM:

CRP: PCT: S.albumin: S.creatinine:
B.UREA: GFR:

VIRAL MARKERS:

RADIOLOGICAL FINDINGS:

LABORATORY PARAMETERS: A.SPECIMEN

B.LAB ID

C.DATE

TESTS:

***DIRECT MICROSCOPIC EXAMINATION:**

A. GRAM STAINING

B.KOH MOUNT

C.INDIA INK PREPRATION

D.ZN STAINING

E.WET MOUNT

***BACTERIAL/ CRYPTOCOCCAL ANTIGEN**

Signature of Candidate **Signature of Supervisor**

*__BACTERIAL CULTURE:__

A. IDENTIFICATION

B. AST

__*BLOOD CULTURE__

* __FUNGAL CULTURE:__

__* MYCOBACTERIAL CULTURE(LJ/MGIT)__

1. SEROLOGICAL INVESTIGATIONS

2.MOLECULAR INVESTIGATIONS

3.OTHER INVESTIGATIONS:

FOLLOW UP:

OUTCOMES/TREATMENT:

Signature of Candidate **Signature of Supervisor**

INFORMED PATIENT CONSENT

Date: _____

I…….D/o, W/o, S/o……..…… am willing to participate in the study **"TO STUDY PROFILE OF INFECTIONS IN PATIENTS OF END STAGE RENAL DISEASE ON MAINTENANCE HEMODIALYSIS"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

……. ……
Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____

निवासी _____

इस शोधकार्य "**TO STUDY PROFILE OF INFECTIONS IN PATIENTS OF END STAGE RENAL DISEASE ON MAINTENANCE HEMODIALYSIS"** में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____	_____
गवाह के हस्ताक्षर	रोगी के हस्ताक्षर/अंगूठे का निशान
नाम:	नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

“TO STUDY PROFILE OF INFECTIONS IN PATIENTS OF END STAGE RENAL DISEASE ON MAINTENANCE HEMODIALYSIS” ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____ _____

ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

_____

ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

_____

ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ